Black Beauty Coal
Vermilion Grove Mine
Surface Water Quality Analysis

Prepared by
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The purpose of this report is to summarize surface water quality sampling results from Black Beauty Coal Company's Vermillion Grove Mine. Vermilion Grove Mine is an underground coal mine in east-central Illinois located upstream of the Little Vermilion River. The permitted area includes 411.5 acres that includes: a preparation plant, soil and coal stockpiles, rail road loop and rail load-out facility, ventilation shafts, office, shop, bath house, roads, refuse disposal area, diversions, and three sedimentation ponds in series. Runoff from the mine site is directed to sediment basin 003 (13SW-12), which discharges to an Unnamed Tributary of the Little Vermilion River.

As required by the NPDES permit dated January 10, 2001, the mine conducted sampling at the sedimentation pond Outfall 003 (13SW-12), at a sample location upstream (13SW-13) of the confluence of the unnamed tributary and Outfall 003, from upstream (11SW-14) and downstream (11SW-15) locations from the confluence of the unnamed tributary and the Little Vermilion River, and on the Little Vermilion River (Georgetown Lake) immediately above the Georgetown dam (6SW-16). Surface water sampling sites are summarized in Table 1 and shown on Figure 1. Samples were collected by grab sample methods during discharge events starting in 2001 and ending in 2007 for the five sample locations. Sample locations 13SW-12 and 13SW-13 include sample data into 2010. Up to a maximum of 10 discharge events per year were required to be sampled.

Permit requirements allow offsite discharge only when the flow rate in the receiving stream is three times that of the sediment basin outfall. Discharges from sedimentation pond Outfall 3 are controlled by a valve-structure. Samples from the surface water sites and the sedimentation basin discharge were analyzed for Temperature, DO, SpC, Volatile Suspended Solids, TSS, Total Ammonia, Alkalinity, Acidity, Hardness, pH, TDS, Cl, SO_4, Hg_T, Ba_T, Ba_D, B_T, B_D, Cd_T, Cd_D, $Cr(III)_T$, $Cr(III)_D$, Cu_T, Cu_D, Fe_T, Fe_D, Pb_T, Pb_D, Mn_T, Mn_D, Ni_T, Ni_D, Ag_T, Ag_D, Zn_T, and Zn_D. The data was analyzed using a variety of statistics including a comparison of the mean, maximum, and minimum chemical concentrations, Time series plots of individual parameters, and using an ANOVA statistic to compare population means of individual parameters between the sample points.

Tables 2 and 3 compare mean, maximum, and minimum chemical concentrations, respectively, of the mine outfall (13SW-12) to upstream sites (13SW-13 and 11SW-14). It can be seen that there are very few differences in chemical composition of mine affected water and upstream waters. Concentrations of inorganic chemicals, specifically sulfate, chloride, and TDS are higher at the mine outfall than in receiving streams. The higher concentrations of these parameters are likely due to the weathering of coal and refuse material contained within the mine site. Results for heavy metals indicate there is little or no difference between mine affected water and upstream waters.

Time series graphs of heavy metal concentrations at surface water sites are shown in Appendix B. Again, the graphs show concentrations at the mine outfall appear to be consistent with the up stream surface water stream sampling locations.

In order to determine if there are any statistically significance differences in mean concentrations of the heavy metals between the sample locations, an analysis of variance (ANOVA) was conducted using data from the mine outfall and the two upstream sites. According to EPA's Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities Unified Guidance March 2009, the analysis of variance is an acceptable method to use to compare mean concentrations. This procedure compares the means of different sampling locations and determines whether there are any significant differences among the sampling locations. Results of the ANOVA can be seen in Table 4. Based on this analysis, none of the heavy metals showed a statistically significant difference between the outfall mean concentration and the upstream mean concentration except for boron (dissolved and total), iron (total), and manganese (total). The ANOVA comparisons do not identify whether the outfall concentrations are statistically greater than the upstream locations only that there a statistically significant differences in mean concentrations.

Time series graphs of all chemicals that showed a statistically significant difference are shown in Appendix A. Time series graphs of all other heavy metals are shown in Appendix B.

As shown in Table 3, total boron concentrations are within the range of background and dissolved boron concentrations are comparable to background. Therefore, although the *mean* boron concentration shows a statistically significant difference, outfall concentrations are still comparable to the *range* of concentrations at upstream sampling sites. Furthermore, since mining has stopped and reclamation completed, boron concentrations have decreased to pre-mining levels. Total iron shows a similar relationship. The iron ranges seen during mining are within the range of background and again, since mining has stopped and reclamation completed, iron concentrations have decreased to pre-mining levels. Total manganese does show concentrations above those found in background and recent samples show that levels have not yet decreased to pre-mining concentrations. However, it is expected that manganese, similar to iron and boron, will return to pre-mining levels in time.

Under alkaline or neutral conditions, heavy metals do not readily leach out of coal or refuse materials and are not expected to be a significant component of mine runoff. For this reason, many materials handling processes are aimed specifically at minimizing any potential for acidic conditions to develop. These include minimizing stockpile area, minimizing exposure of disturbed areas and refuse, special handling requirements for coarse and fine refuse, and compaction and covering of material within the refuse pile. Furthermore, all upstream unaffected water is diverted around the mine site to prevent exposure to disturbed material and avoid unnecessary treatment of unaffected water.

In summary, Vermilion Grove Mine conducted surface water sampling both upstream and downstream of a sediment basin outfall that received all runoff from the mine site. After five years of sampling, this analysis has shown that, for the majority of analytes, concentrations at the mine outfall are not statistically different from background concentrations. Rather than requiring analysis of such an extensive list of analytes, the same level of protection could have been achieved through the use of indicator parameters.

TABLES

Table 1
Surface Water Monitoring Locations and Descriptions.

Vermilion Grove Site No.	Sample Point ID	Vermilion Grove Site Description	Sampling Date Range	No. of Sample Events
Site 1	13SW-12	Basin 003 Outfall	02/12/2001 - 07/26/2010	169
Site 2	13SW-13	Unnamed Tributary of LVR, upstream from 003 discharge	02/12/2001 - 07/26/2010	126
Site 3	11SW-14	Little Vermilion River, upstream from unnamed tributary	02/12/2001 - 04/04/2007	45
Site 4	11SW-15	Little Vermilion River, downstream from unnamed tributary	02/12/2001 - 04/04/2007	45
Site 5	6SW-16	Little Vermilion River, Georgetown Reservoir dam	02/12/2001 - 04/04/2007	45

Note: Table 1 includes sampling date range and total number of samples taken during the review period.

Table 2
Mean Chemical Concentrations
Vermilion Grove Sample Locations Analysis

Parameter	Units	13SW-12	13SW-13	11SW-14
		Average	Average	Average
Temp	[C°]	13.88	11.37	10.41
Hardness	[mg/L]	320	242	248
TDS	[mg/L]	949	404	368
pH Field	[S.U.]	8.05	7.93	7.90
pH Lab	[S.U.]	7.94	7.78	--
Acidity	[mg/L]	6	12	13
Alkalinity	[mg/L]	135	177	205
Cl	[mg/L]	244	78	51
SO4	[mg/L]	302	42	34
TSS	[mg/L]	25.40	34.23	70.23
SS	[mL/L]	0.17	--	--
DO	[mg/L]	9.46	9.35	8.97
Flow	[cfs]	10.63	47.07	147.78
Ba_D	[mg/L]	0.084	0.110	0.102
Ba_T	[mg/L]	0.055	0.057	0.062
B_D	[mg/L]	0.142	0.077	0.067
B_T	[mg/L]	0.144	0.085	0.070
Cd_D	[mg/L]	0.002	0.002	0.002
Cd_T	[mg/L]	0.002	0.002	0.002
Cr_D	[mg/L]	0.002	0.002	0.002
Cr_T	[mg/L]	0.003	0.004	0.004
Cu_D	[mg/L]	0.005	0.003	0.004
Cu_T	[mg/L]	0.003	0.004	0.005
Fe_D	[mg/L]	0.093	0.162	0.177
Fe_T	[mg/L]	0.946	1.981	2.335
Pb_D	[mg/L]	0.002	0.002	0.002
Pb_T	[mg/L]	0.002	0.002	0.002
Mn_D	[mg/L]	0.086	0.044	0.022
Mn_T	[mg/L]	0.211	0.065	0.060
Ni_D	[mg/L]	0.005	0.003	0.002
Ni_T	[mg/L]	0.005	0.004	0.003
Ag_D	[mg/L]	0.002	0.002	0.002
Ag_T	[mg/L]	0.002	0.002	0.002
Zn_D	[mg/L]	0.027	0.033	0.030
Zn_T	[mg/L]	0.014	0.021	0.021
Hg_D	[mg/L]	0.0002	0.0002	0.0002
Hg_T	[mg/L]	0.0002	0.0002	0.0002
Cr(VI)	[mg/L]	0.018	0.018	0.018
Cr(III)	[mg/L]	0.010	0.012	0.012
Cr(IIID)	[mg/L]	0.004	0.003	0.003
NH_{4T}	[mg/L]	1.05	1.00	1.01

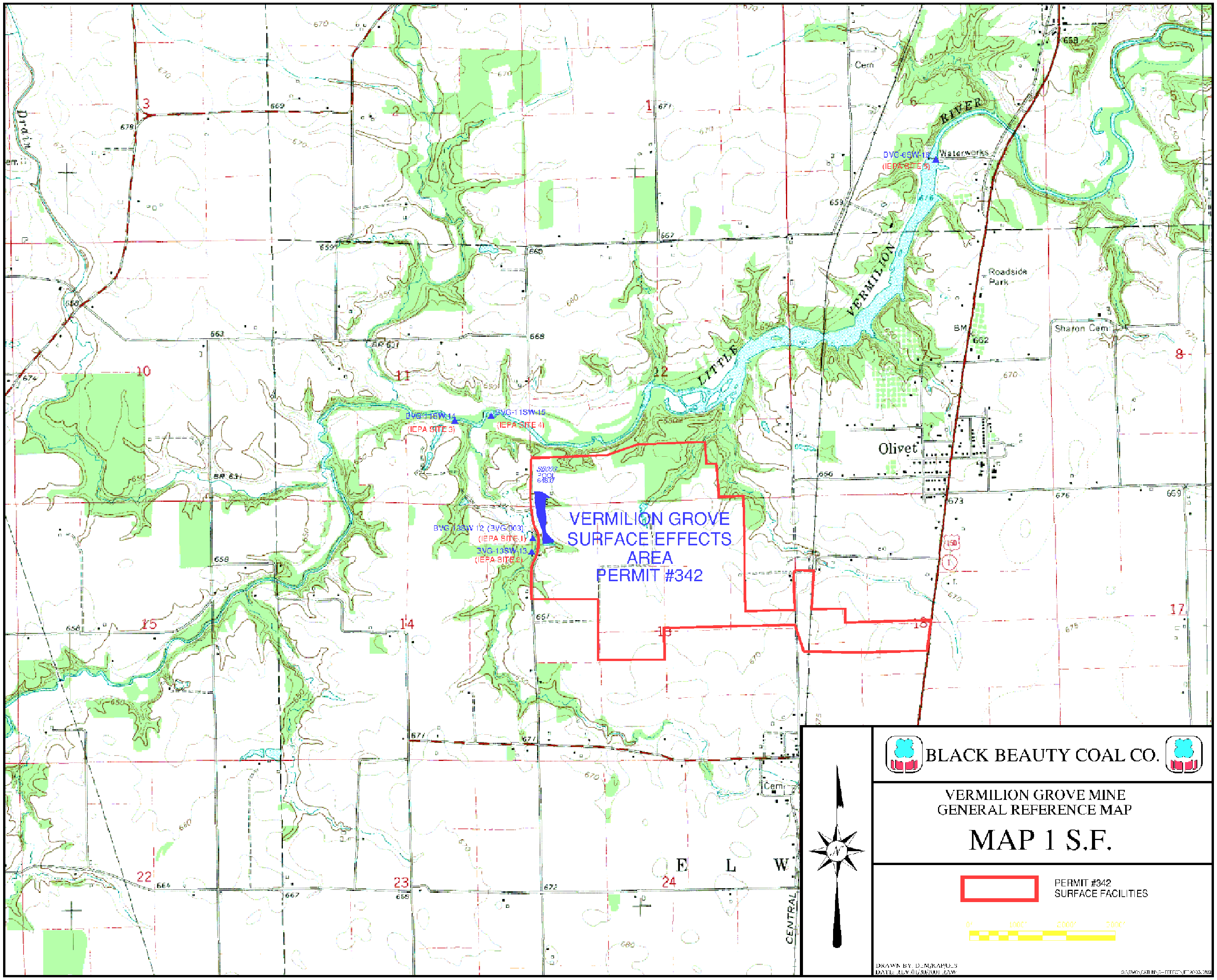
Table 3
Maximum and Minimum Chemical Concentrations
Vermilion Grove Sample Locations

Parameter	Units	13SW-12		13SW-13		11SW-14	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Temp	[C°]	1.89	28.20	2.60	24.30	2.78	24.40
Hardness	[mg/L]	50	780	140	340	110	370
TDS	[mg/L]	166	4608	192	1277	134	870
pH Field	[S.U.]	6.42	8.82	6.44	8.60	6.37	9.30
pH Lab	[S.U.]	6.88	9.28	7.16	8.20	--	--
Acidity	[mg/L]	-74	123	1	164	1	122
Alkalinity	[mg/L]	52	330	74	288	85	408
Cl	[mg/L]	10	767	10	742	3	394
SO4	[mg/L]	10	935	10	308	1	148
TSS	[mg/L]	1.00	198	1.00	190	2.00	327
SS	[mL/L]	0.04	0.40	--	--	--	--
DO	[mg/L]	5.84	17.44	5.32	16.60	5.02	11.88
Flow	[cfs]	0.00	143.91	0.88	540.27	125.00	155.00
Ba_D	[mg/L]	0.031	0.320	0.027	0.544	0.030	0.864
Ba_T	[mg/L]	0.031	0.082	0.033	0.136	0.040	0.137
B_D	[mg/L]	0.041	0.294	0.020	0.281	0.015	0.218
B_T	[mg/L]	0.022	0.501	0.002	0.652	0.014	0.443
Cd_D	[mg/L]	0.002	0.002	0.002	0.002	0.002	0.002
Cd_T	[mg/L]	0.002	0.002	0.002	0.002	0.002	0.002
Cr_D	[mg/L]	0.002	0.004	0.002	0.008	0.002	0.004
Cr_T	[mg/L]	0.002	0.038	0.002	0.026	0.002	0.026
Cu_D	[mg/L]	0.002	0.087	0.002	0.038	0.002	0.030
Cu_T	[mg/L]	0.002	0.010	0.002	0.027	0.002	0.022
Fe_D	[mg/L]	0.005	0.889	0.005	1.160	0.005	1.640
Fe_T	[mg/L]	0.005	11.90	0.005	14.50	0.005	15.70
Pb_D	[mg/L]	0.002	0.005	0.002	0.003	0.002	0.005
Pb_T	[mg/L]	0.002	0.006	0.002	0.006	0.002	0.006
Mn_D	[mg/L]	0.002	1.22	0.002	0.848	0.004	0.190
Mn_T	[mg/L]	0.003	1.17	0.003	0.738	0.002	0.246
Ni_D	[mg/L]	0.002	0.050	0.002	0.033	0.002	0.004
Ni_T	[mg/L]	0.002	0.074	0.002	0.055	0.002	0.025
Ag_D	[mg/L]	0.002	0.002	0.002	0.002	0.002	0.006
Ag_T	[mg/L]	0.002	0.005	0.002	0.008	0.002	0.007
Zn_D	[mg/L]	0.002	0.134	0.002	0.152	0.002	0.157
Zn_T	[mg/L]	0.002	0.154	0.002	0.123	0.002	0.142
Hg_D	[mg/L]	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Hg_T	[mg/L]	0.0002	0.0007	0.0002	0.0002	0.0002	0.0002
Cr(VI)	[mg/L]	0.010	0.020	0.010	0.020	0.010	0.020
Cr(III)	[mg/L]	0.002	0.038	0.002	0.026	0.002	0.026
Cr(IIID)	[mg/L]	0.002	0.020	0.002	0.020	0.002	0.020
NH_{4T}	[mg/L]	1.00	2.00	1.00	1.10	1.00	1.30

Table 4
Values Computed in ANOVA Statistical Analysis.

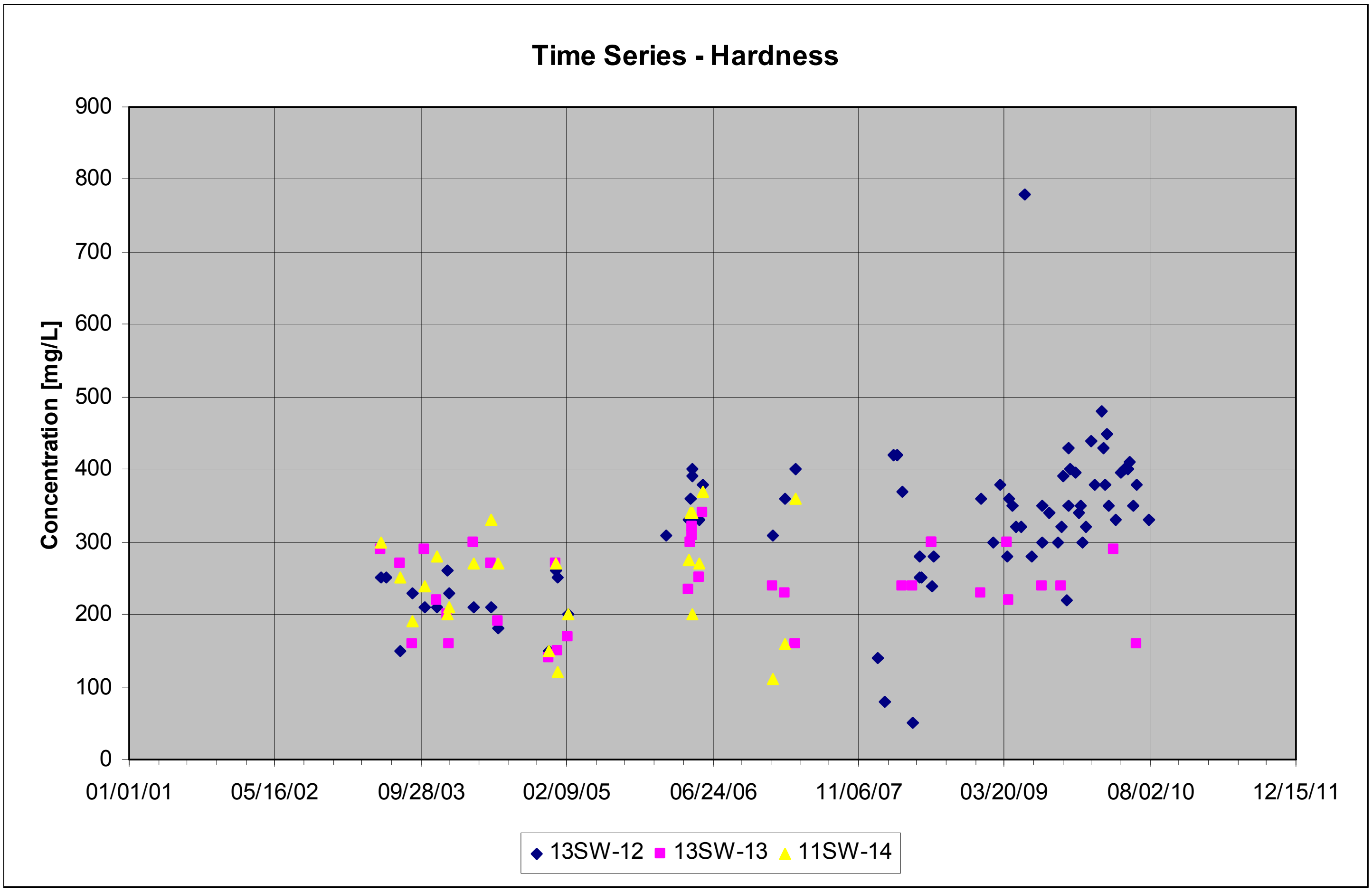
Parameter	Sum of Squares (Wells)	Sum of Squares (Total)	Sum of Squares (Error)	Mean Squares (Wells)	Mean Squares (Error)	Degrees of Freedom (p-1)	Degrees of Freedom (N-p)	F Value (Calculated)	F Value (Table)	Equal Means (All Wells)
Hardness	188106	1196439	1008333	94053	7756	2	130	12.13	3.07	Significant Difference (95%)
TDS	9390606	39623611	30233005	4695303	236195	2	128	19.88	3.07	Significant Difference (95%)
pH Field	0.97	39.59	38.62	0.49	0.20	2	196	2.47	3.07	No Significant Difference
Acidity	2210	136509	134298	1105	678	2	198	1.63	3.07	No Significant Difference
Alkalinity	168965	685086	516121	84483	2607	2	198	32.41	3.07	Significant Difference (95%)
Cl	1640219	6757352	5117134	820109	25208	2	203	32.53	3.07	Significant Difference (95%)
SO_4	3553664	9231666	5678002	1776832	27970	2	203	63.53	3.07	Significant Difference (95%)
TSS	62272	589382	527111	31136	2649	2	199	11.75	3.07	Significant Difference (95%)
DO	5.91	398.48	392.57	2.95	2.93	2	134	1.01	3.07	No Significant Difference
Ba_D	0.02	1.83	1.82	0.01	0.01	2	128	0.54	3.07	No Significant Difference
Ba_T	0.00	0.04	0.04	0.00	0.00	2	128	1.38	3.07	No Significant Difference
B_D	0.15	0.58	0.43	0.07	0.00	2	128	22.01	3.07	Significant Difference (95%)
B_T	0.14	1.13	0.99	0.07	0.01	2	128	8.76	3.07	Significant Difference (95%)
Cd_D	0.0000	0.0000	0.0000	0.0000	0.0000	2	128	0.00	3.07	No Significant Difference
Cd_T	0.0000	0.0000	0.0000	0.0000	0.0000	2	128	0.00	3.07	No Significant Difference
Cr_D	0.0000	0.0001	0.0001	0.0000	0.0000	2	127	0.32	3.07	No Significant Difference
Cr_T	0.0000	0.0030	0.0030	0.0000	0.0000	2	127	0.20	3.07	No Significant Difference
Cu_D	0.0000	0.0102	0.0102	0.0000	0.0001	2	128	0.19	3.07	No Significant Difference
Cu_T	0.0001	0.0024	0.0023	0.0000	0.0000	2	128	2.34	3.07	No Significant Difference
Fe_D	0.18	8.79	8.61	0.09	0.07	2	128	1.35	3.07	No Significant Difference
Fe_T	74.49	1418.59	1344.09	37.25	6.79	2	198	5.49	3.07	Significant Difference (95%)
Pb_D	0.0000	0.0000	0.0000	0.0000	0.0000	2	128	0.39	3.07	No Significant Difference
Pb_T	0.0000	0.0001	0.0001	0.0000	0.0000	2	128	0.30	3.07	No Significant Difference
Mn_D	0.10	3.56	3.46	0.05	0.03	2	128	1.76	3.07	No Significant Difference
Mn_T	1.08	9.36	8.29	0.54	0.04	2	195	12.64	3.07	Significant Difference (95%)
Ni_D	0.0001	0.0048	0.0047	0.0001	0.0000	2	128	1.86	3.07	No Significant Difference
Ni_T	0.0001	0.0099	0.0098	0.0000	0.0001	2	128	0.55	3.07	No Significant Difference
Ag_D	0.0000	0.0000	0.0000	0.0000	0.0000	2	128	1.02	3.07	No Significant Difference
Ag_T	0.0000	0.0001	0.0001	0.0000	0.0000	2	128	0.43	3.07	No Significant Difference
Zn_D	0.0009	0.1484	0.1475	0.0005	0.0012	2	128	0.39	3.07	No Significant Difference
Zn_T	0.0014	0.0896	0.0882	0.0007	0.0007	2	128	1.00	3.07	No Significant Difference
Hg_D	0.0000	0.0000	0.0000	0.0000	0.0000	2	127	0.00	3.07	No Significant Difference
Hg_T	0.0000	0.0000	0.0000	0.0000	0.0000	2	128	1.33	3.07	No Significant Difference
Cr(VI)	0.0000	0.0021	0.0021	0.0000	0.0000	2	127	0.00	3.07	No Significant Difference
Cr(III)	0.0001	0.0096	0.0095	0.0000	0.0001	2	127	0.55	3.07	No Significant Difference
Cr(IIID)	0.0000	0.0022	0.0022	0.0000	0.0000	2	127	0.19	3.07	No Significant Difference
NH_{4T}	0.0513	2.0680	2.0167	0.0256	0.0159	2	127	1.61	3.07	No Significant Difference

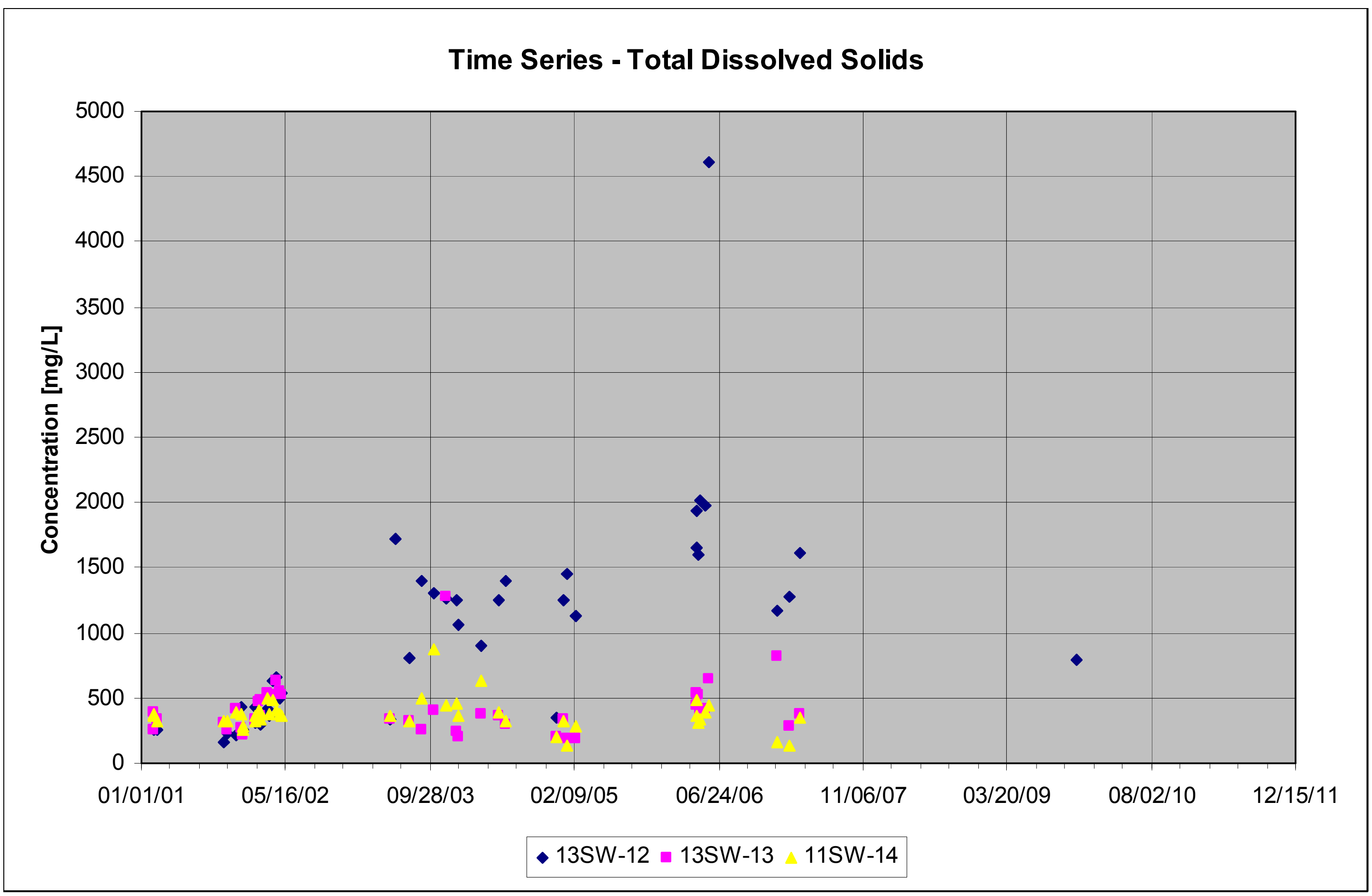
Figure 1
Vermilion Grove Mine Surface Water Sampling Locations.

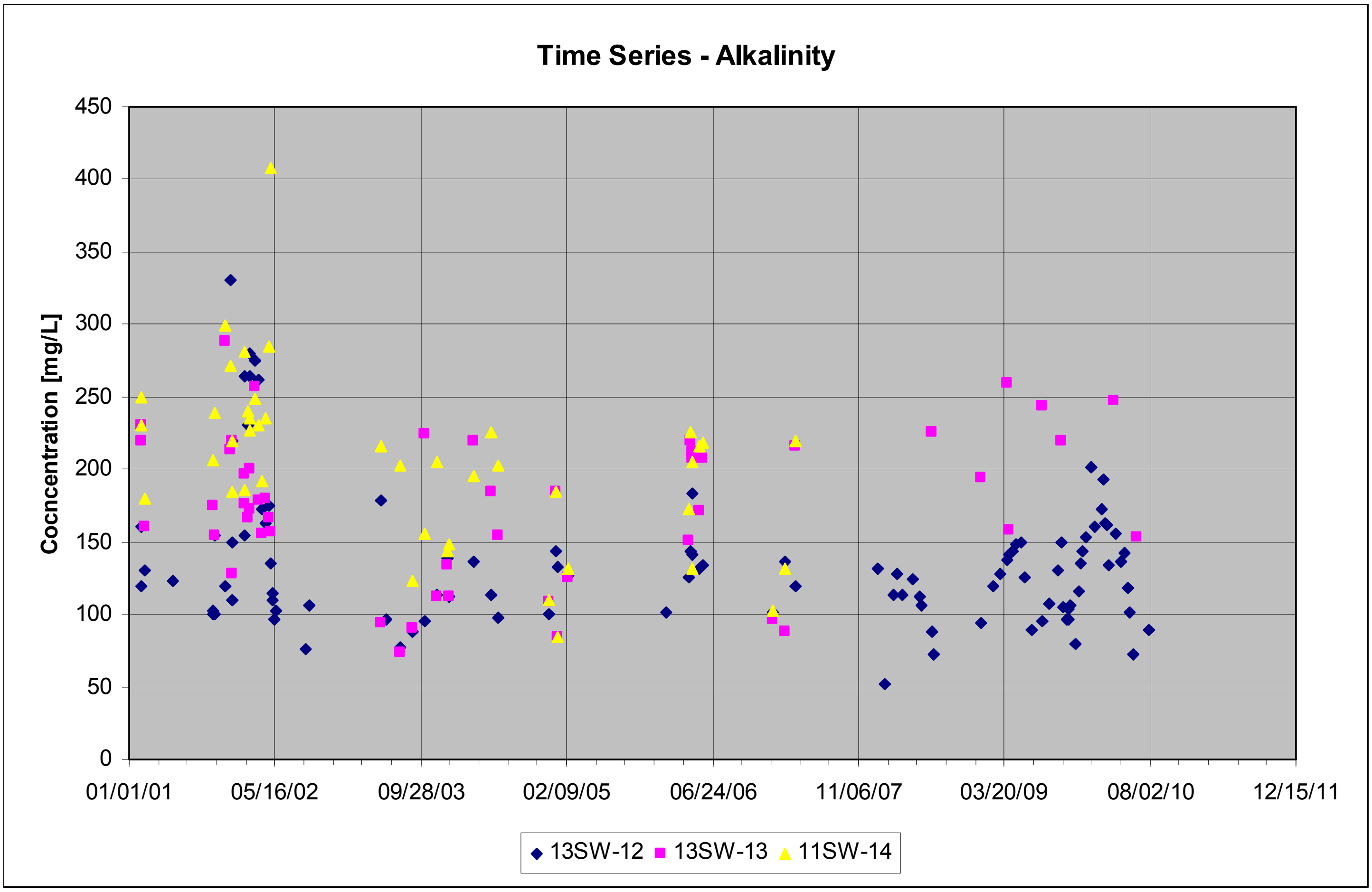


Appendix A

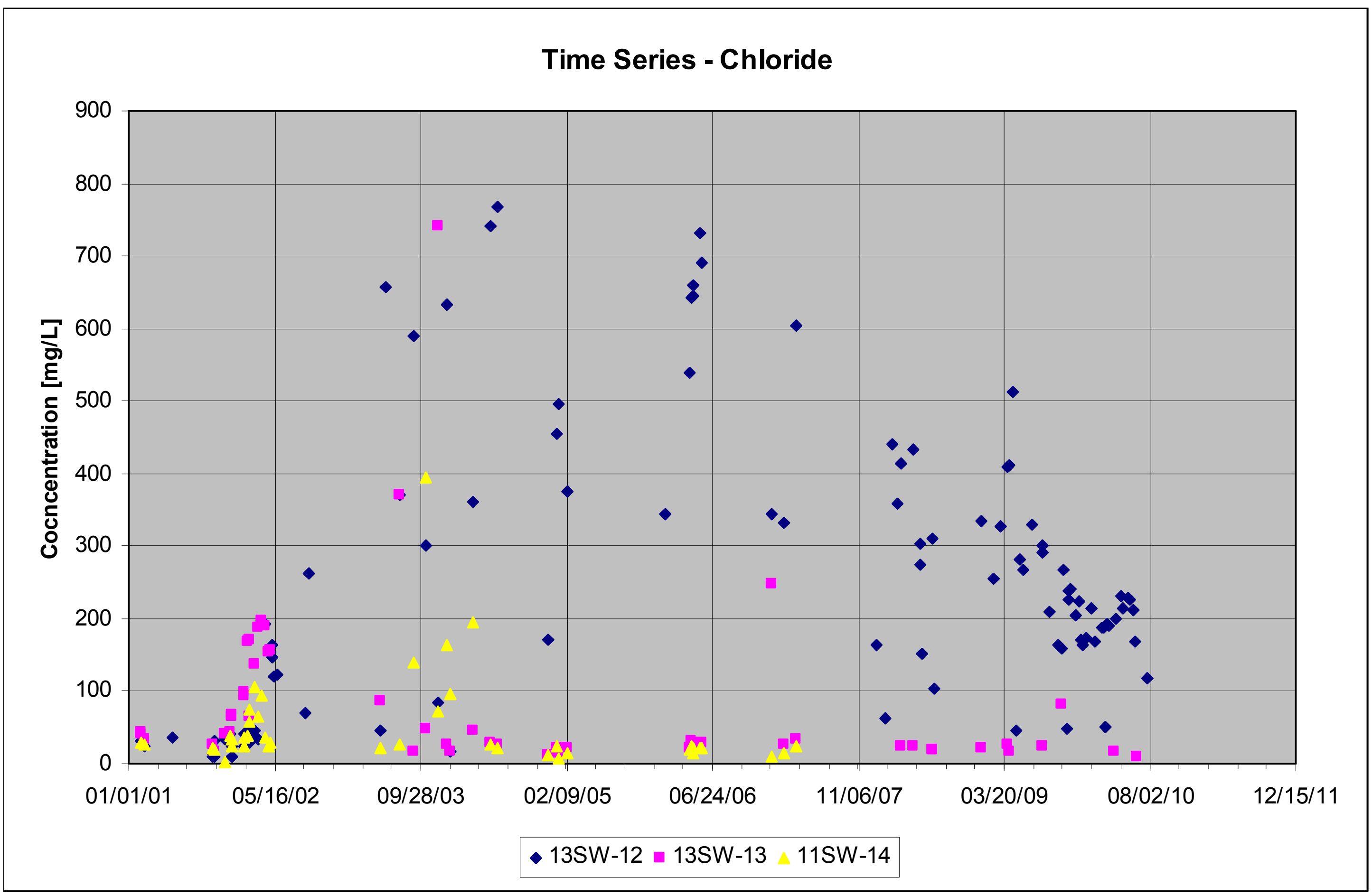
Time Series Graphs for Chemicals Showing A Statistically Significance Difference


Time Series - Hardness
Concentration [mg/L]
900
800
700
600
500
400
300
200
100
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

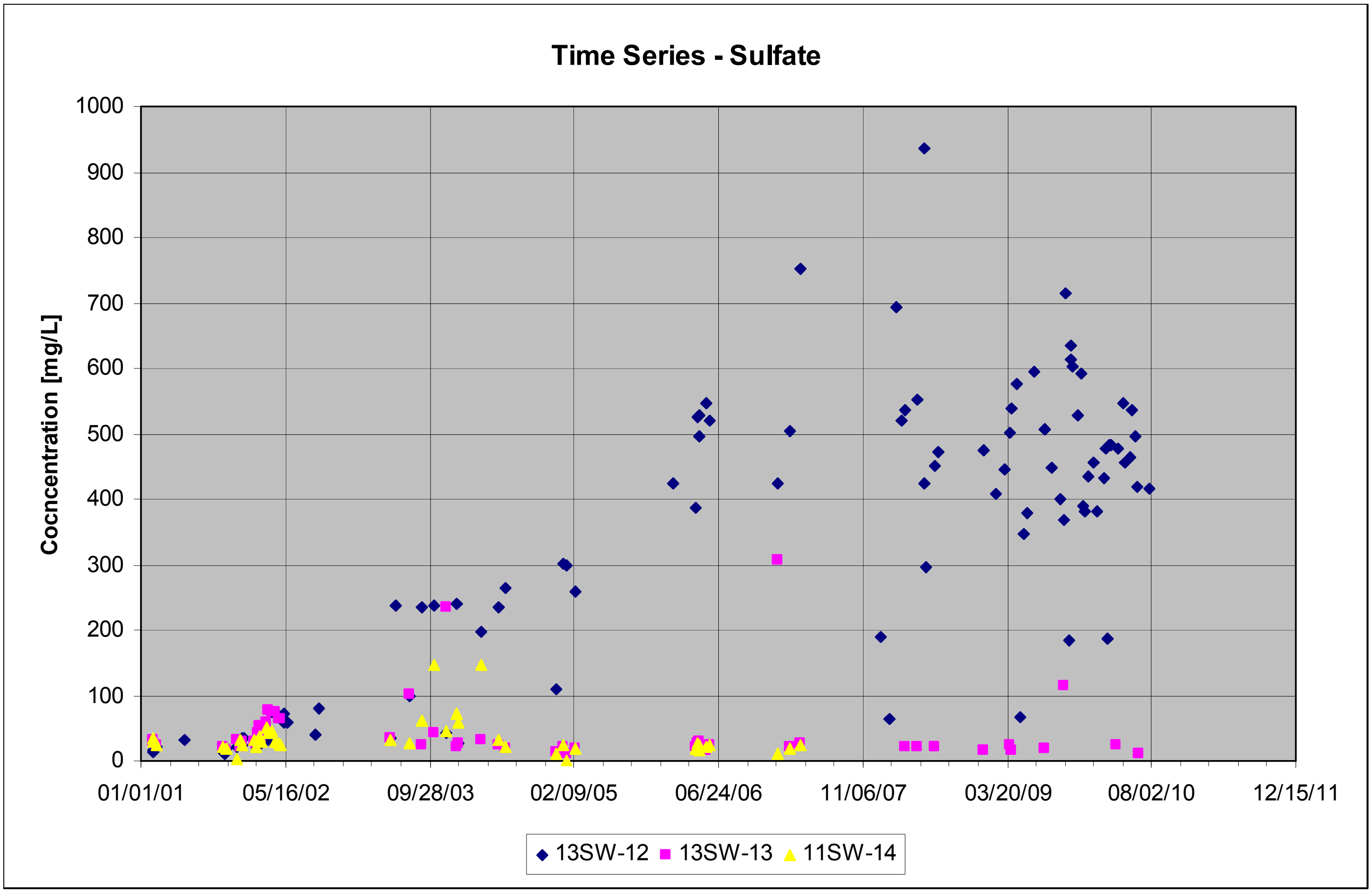

Time Series - Total Dissolved Solids
Concentration [mg/L]
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

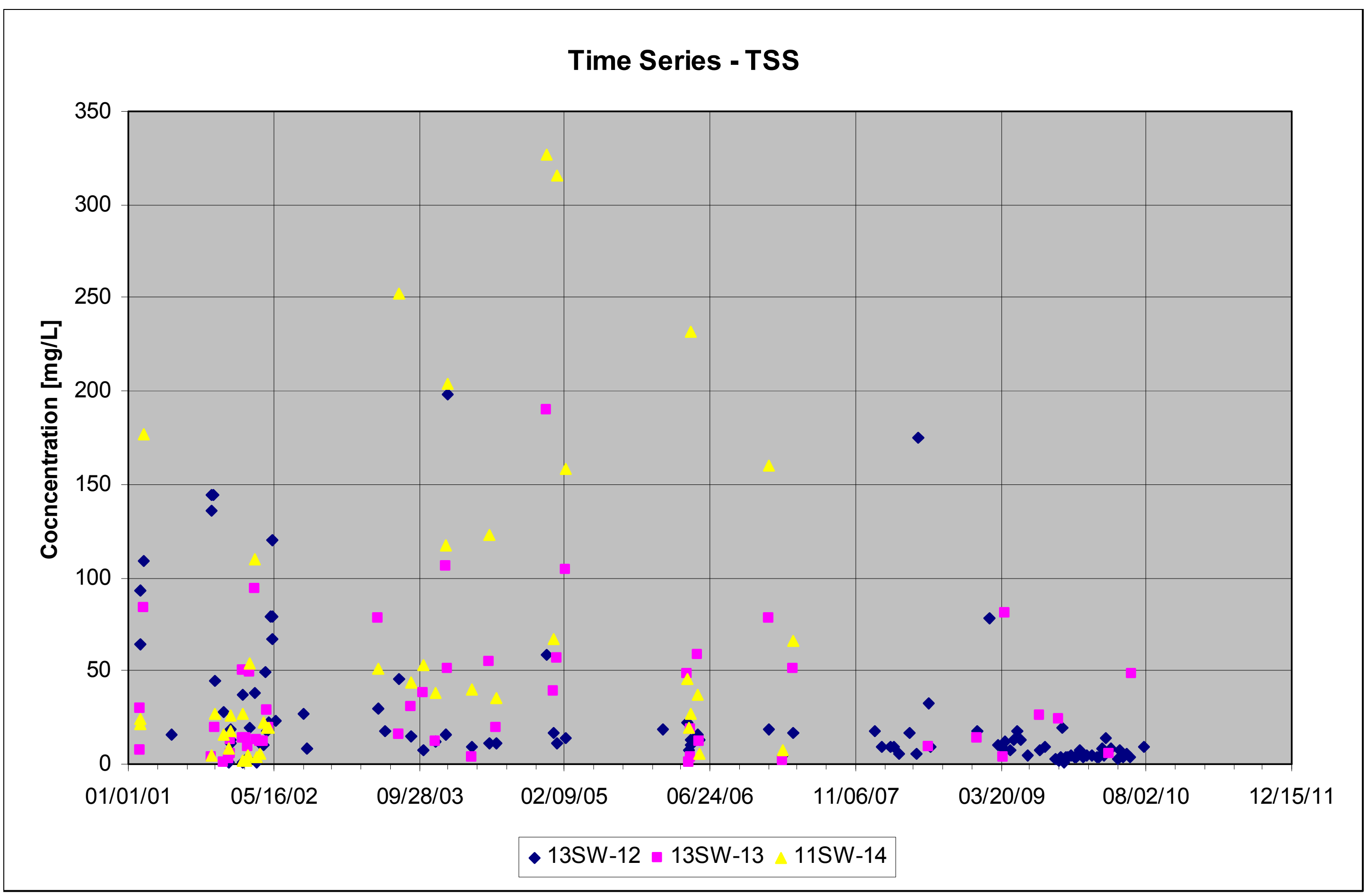


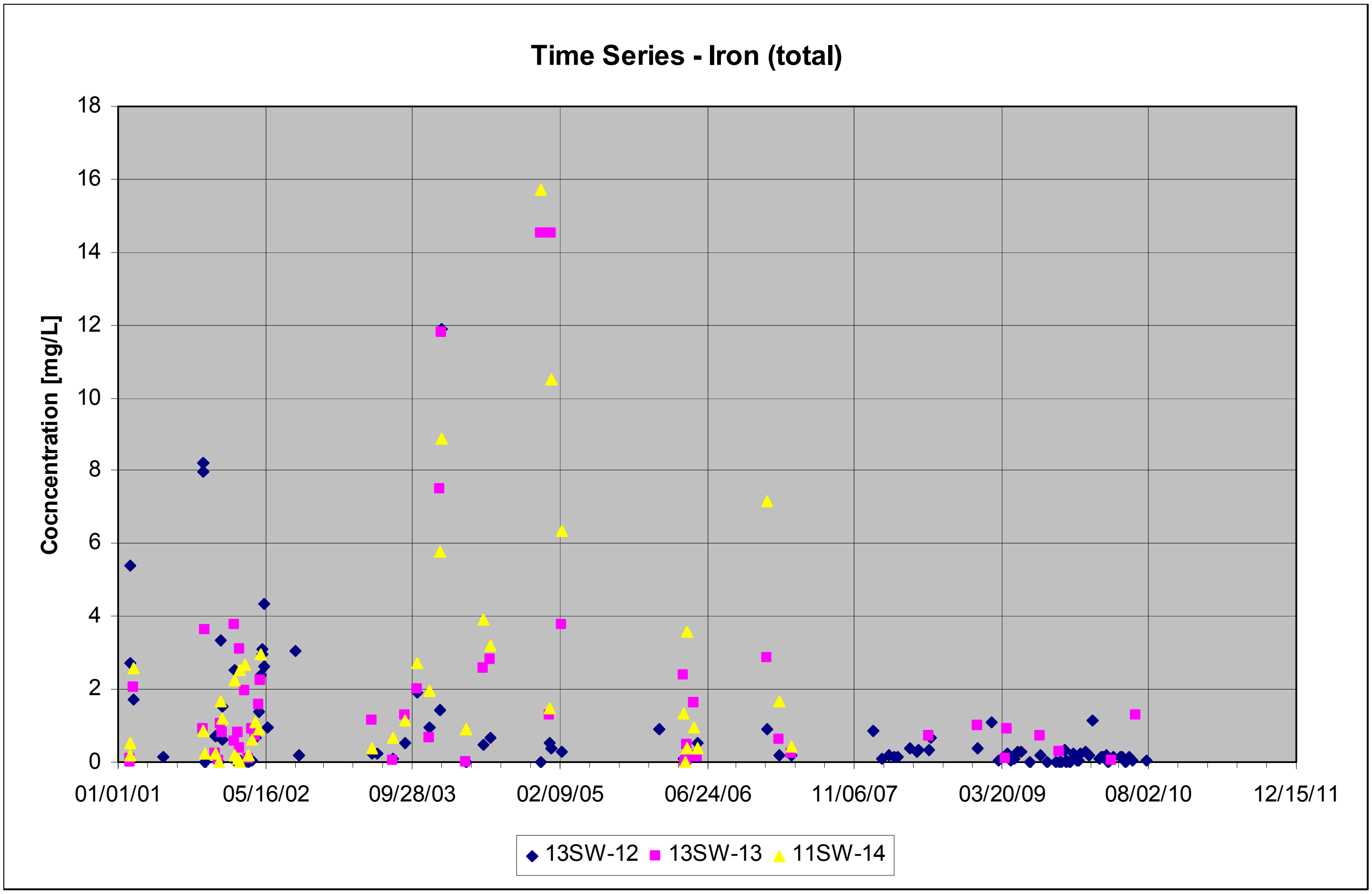
Time Series - Alkalinity
Cocncentration [mg/L]
450
400
350
300
250
200
150
100
50
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

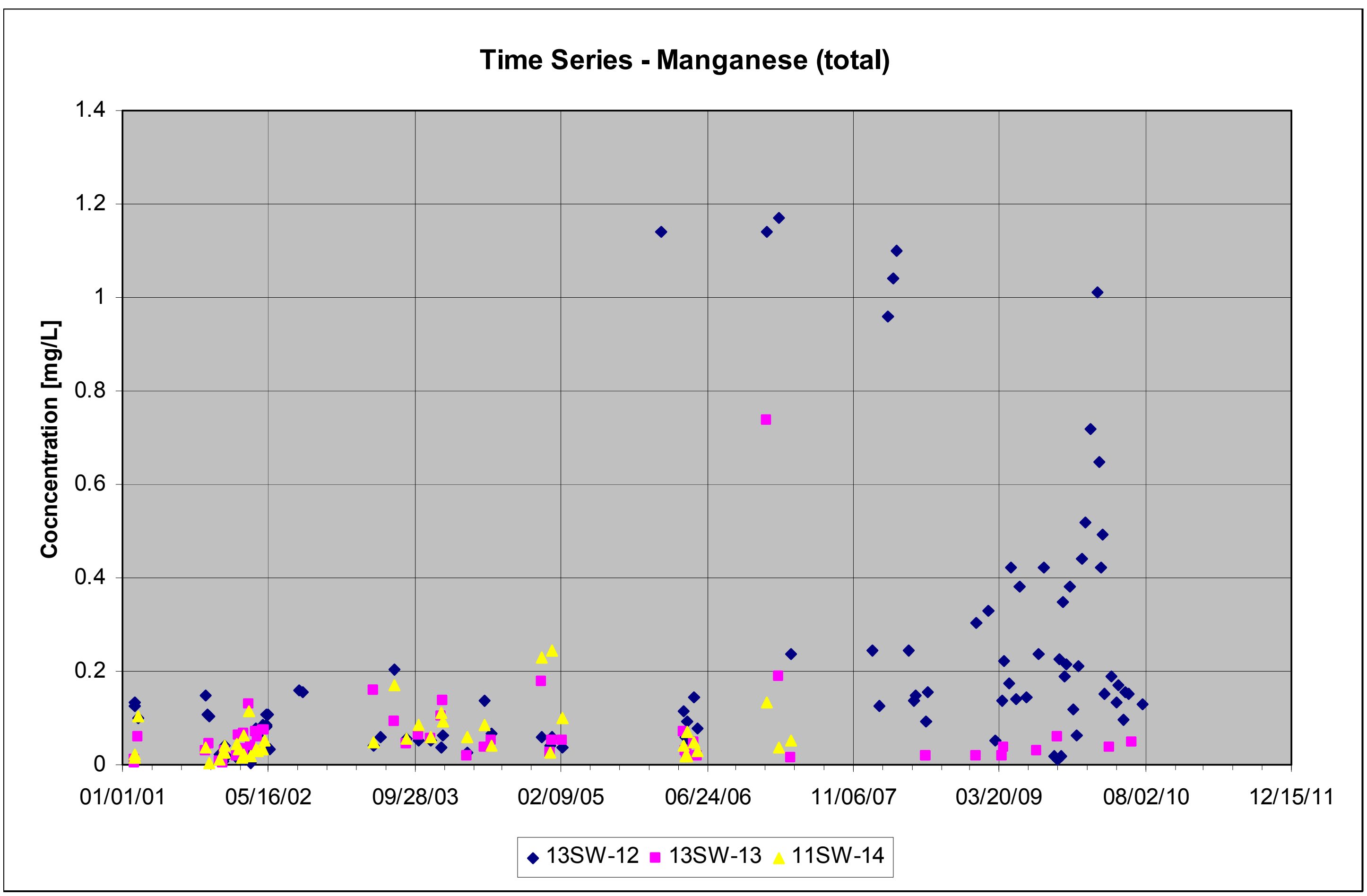


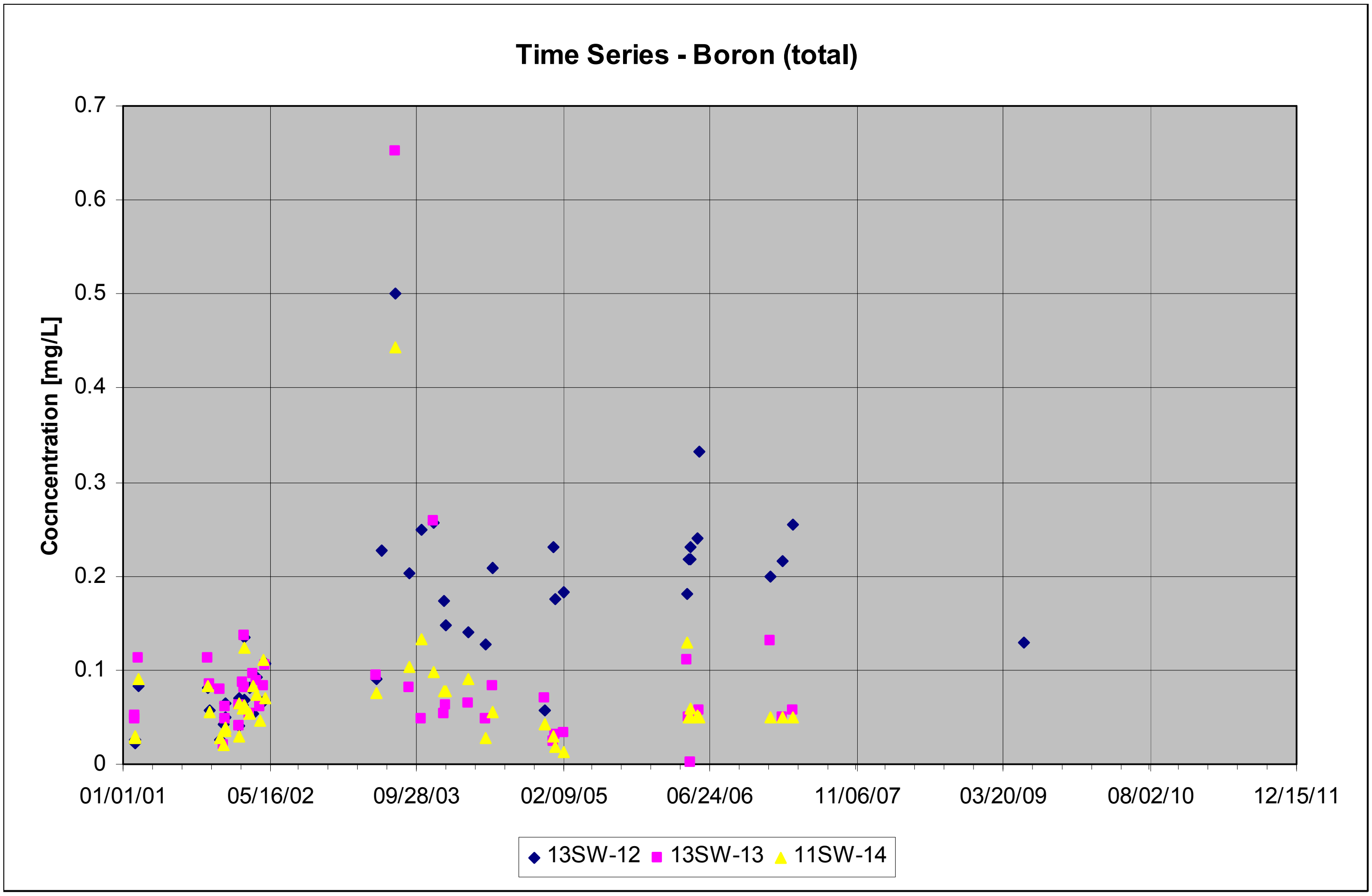
Time Series - Chloride
Cocncentration [mg/L]
900
800
700
600
500
400
300
200
100
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

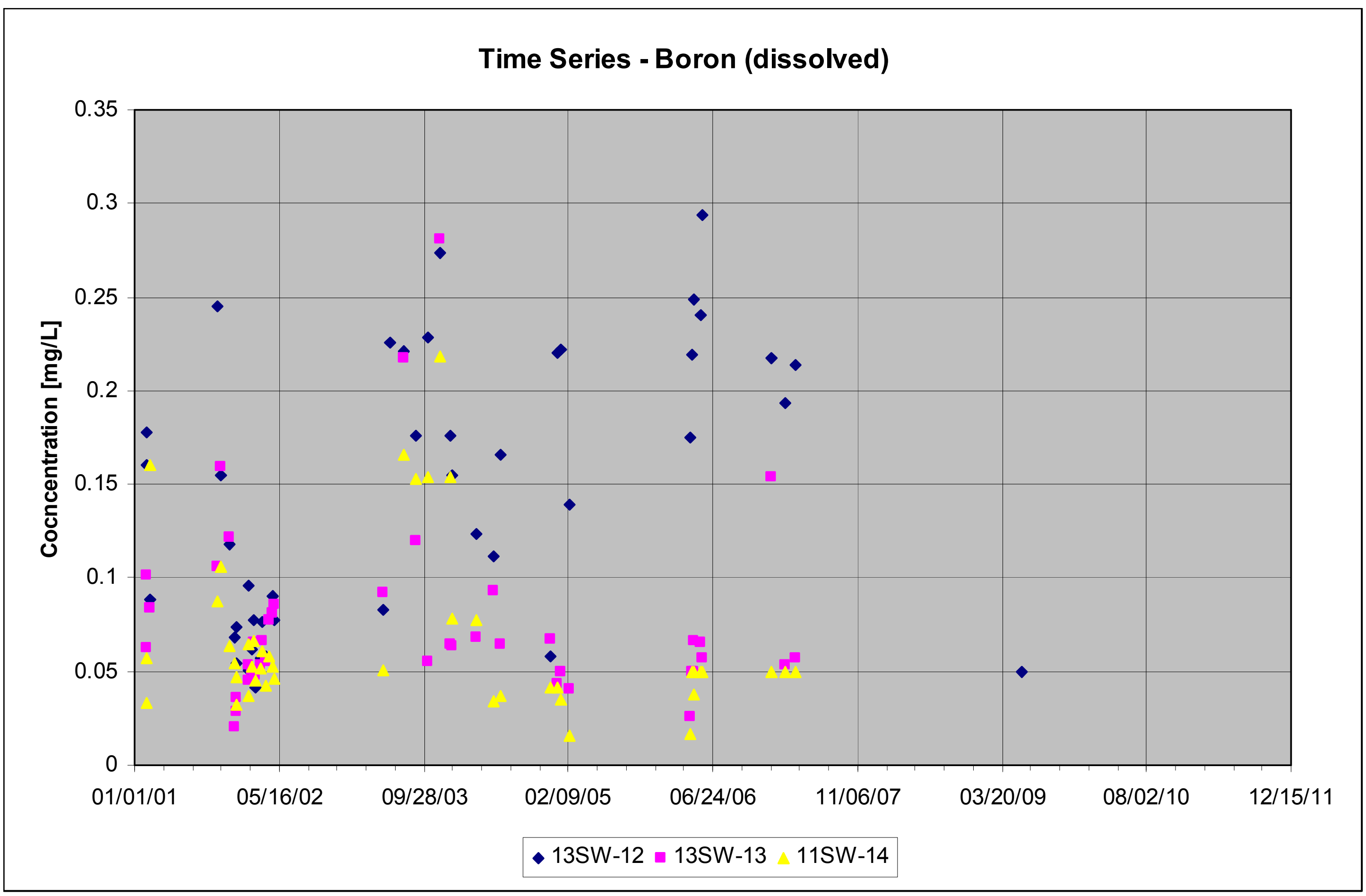

Time Series - Sulfate
Cocncentration [mg/L]
1000
900
800
700
600
500
400
300
200
100
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - TSS
Cocncentration [mg/L]
350
300
250
200
150
100
50
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - Iron (total)
Cocncentration [mg/L]
18
16
14
12
10
8
6
4
2
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

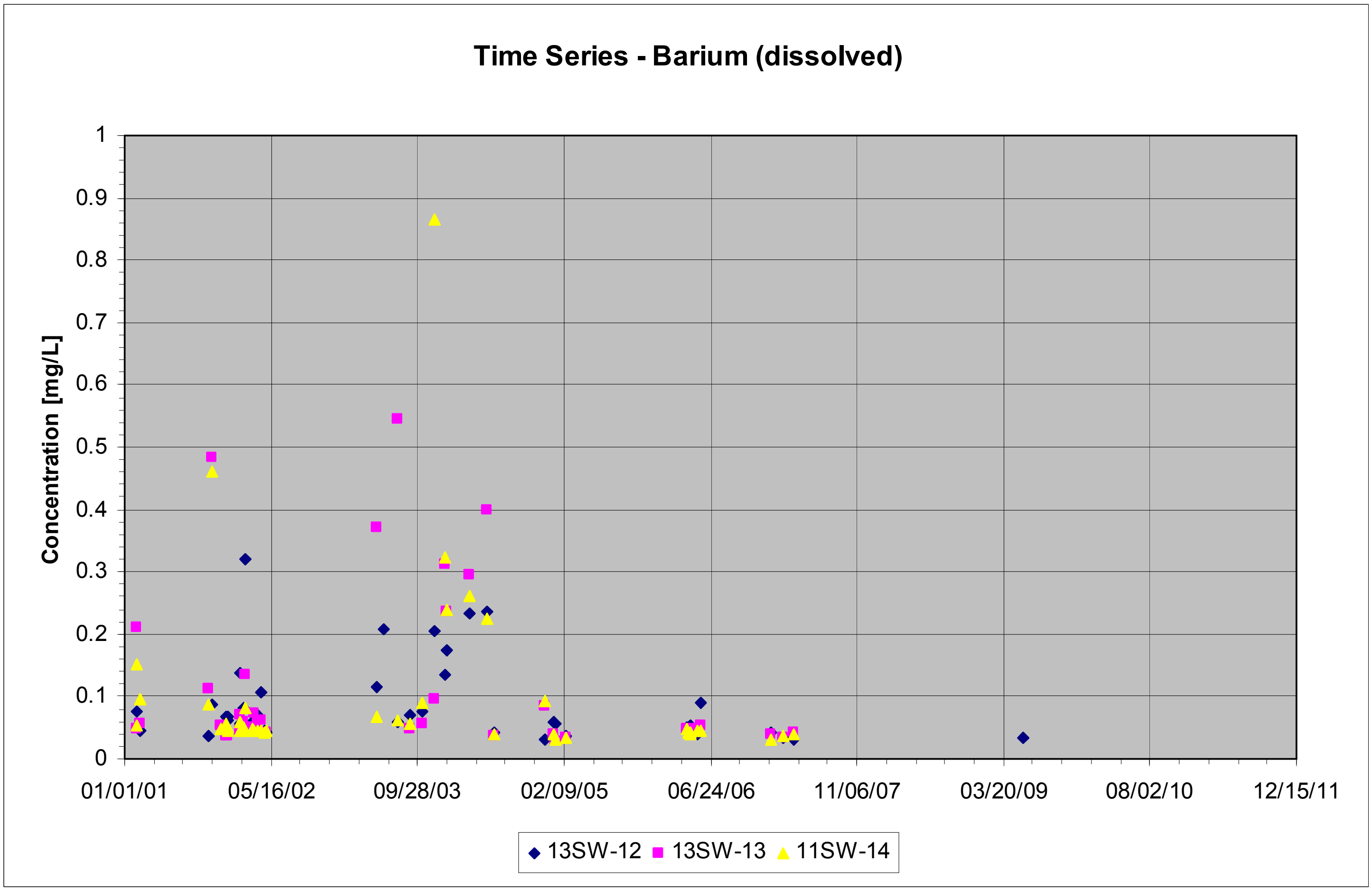

Time Series - Manganese (total)
Cocncentration [mg/L]
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

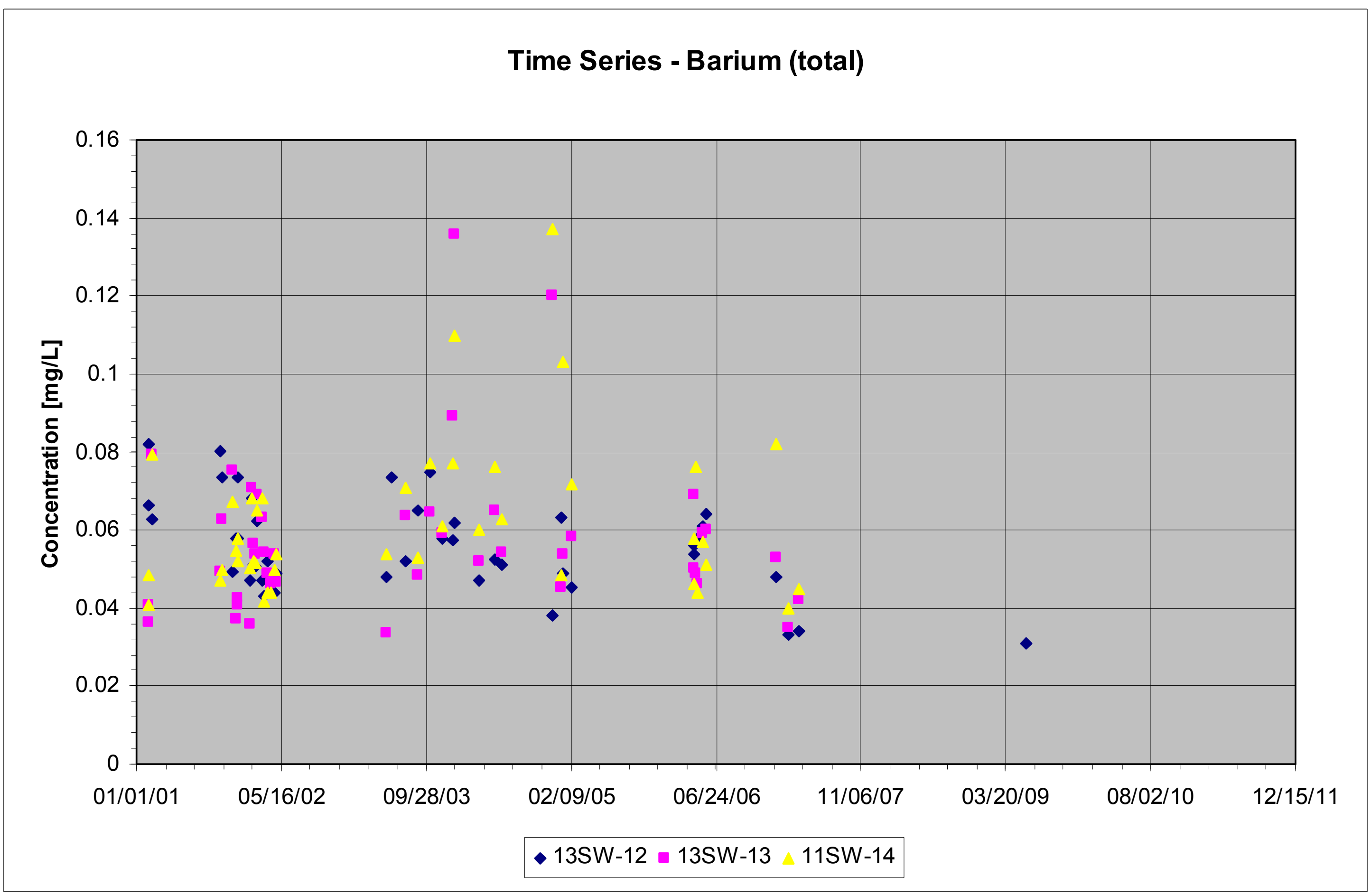

Time Series - Boron (total)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Cocncentration [mg/L]
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

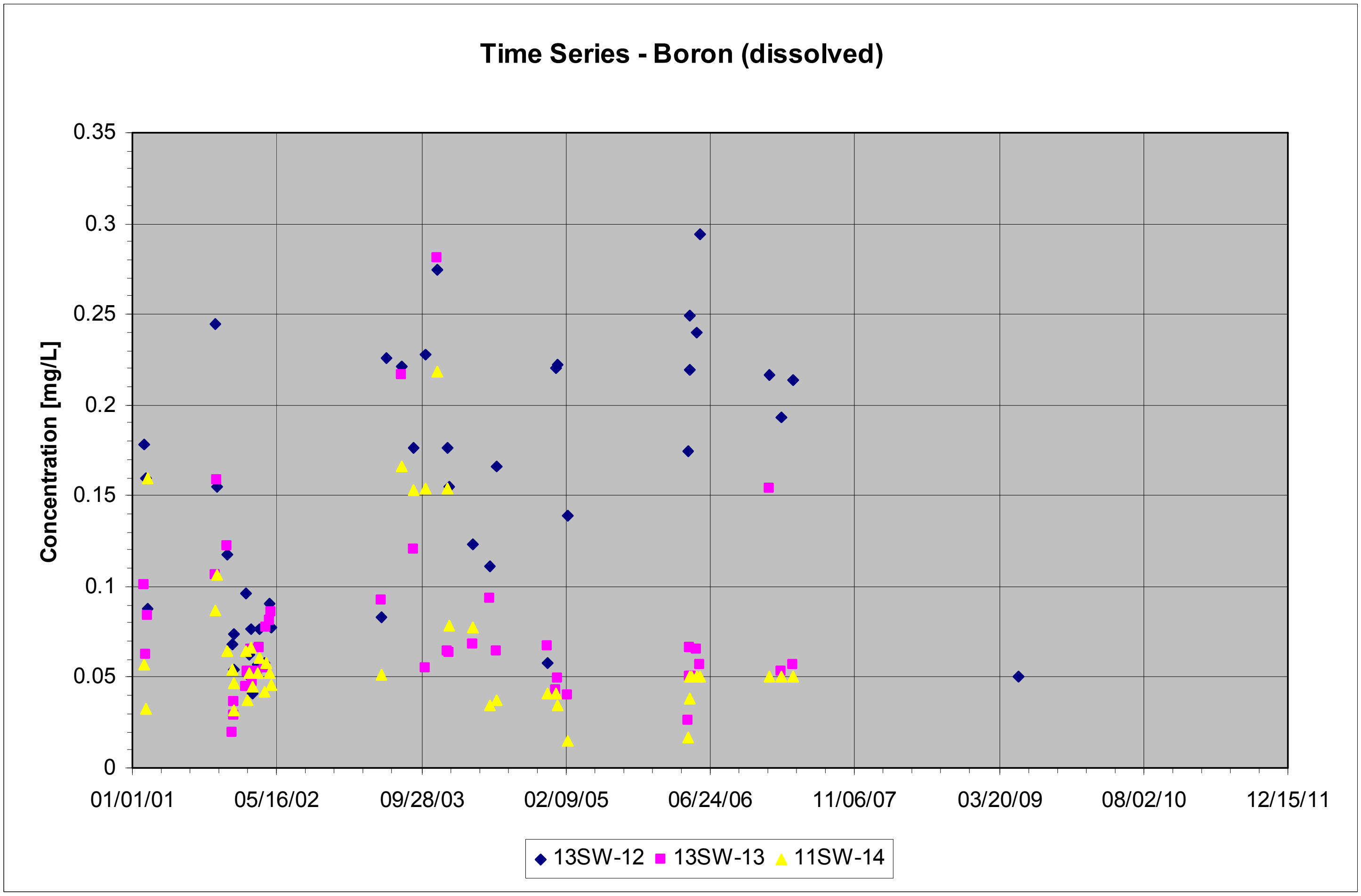

Time Series - Boron (dissolved)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Cocncentration [mg/L]
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

Appendix B

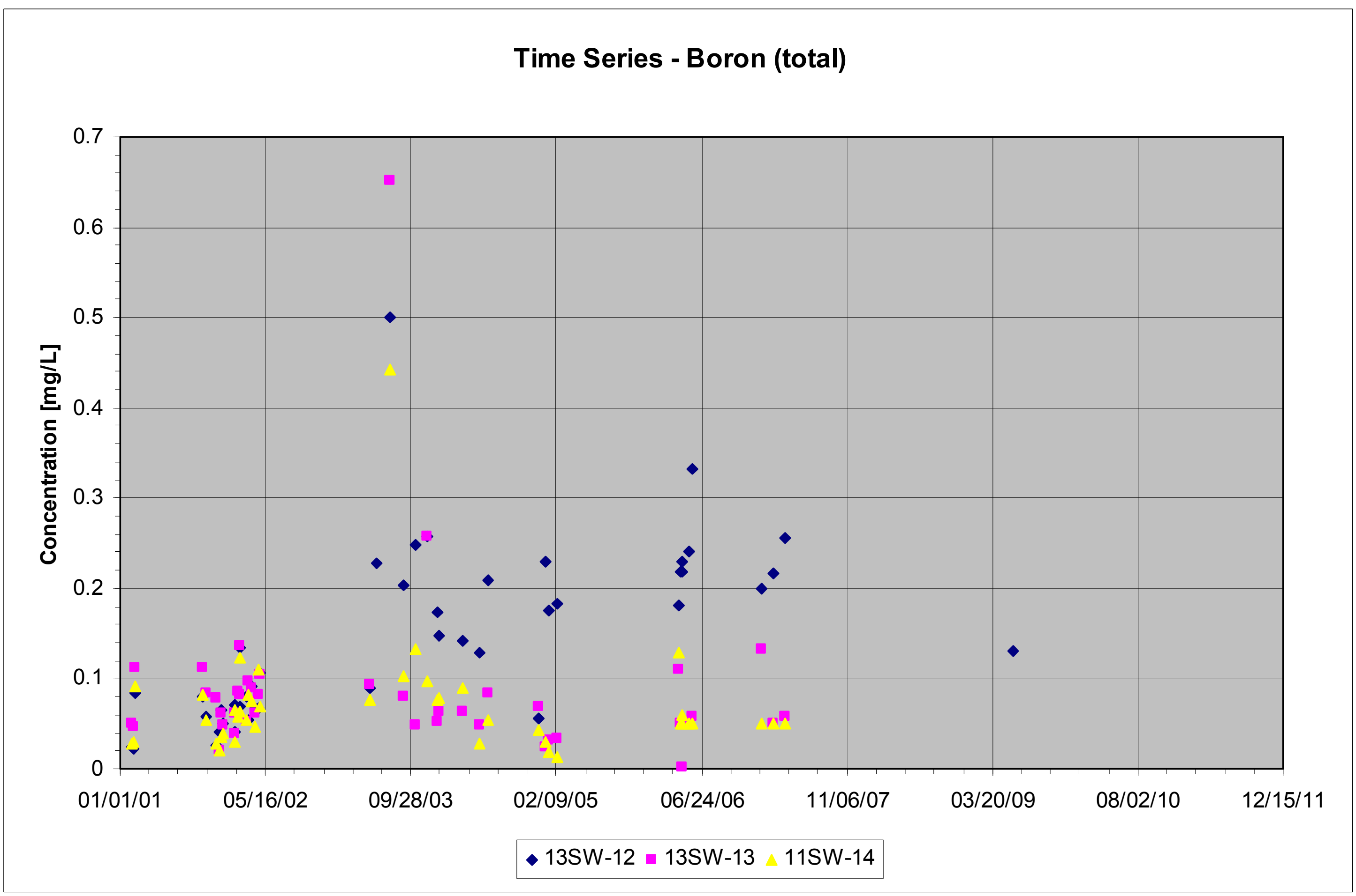
Time Series Graphs
Heavy Metals


Time Series - Barium (dissolved)
Concentration [mg/L]
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

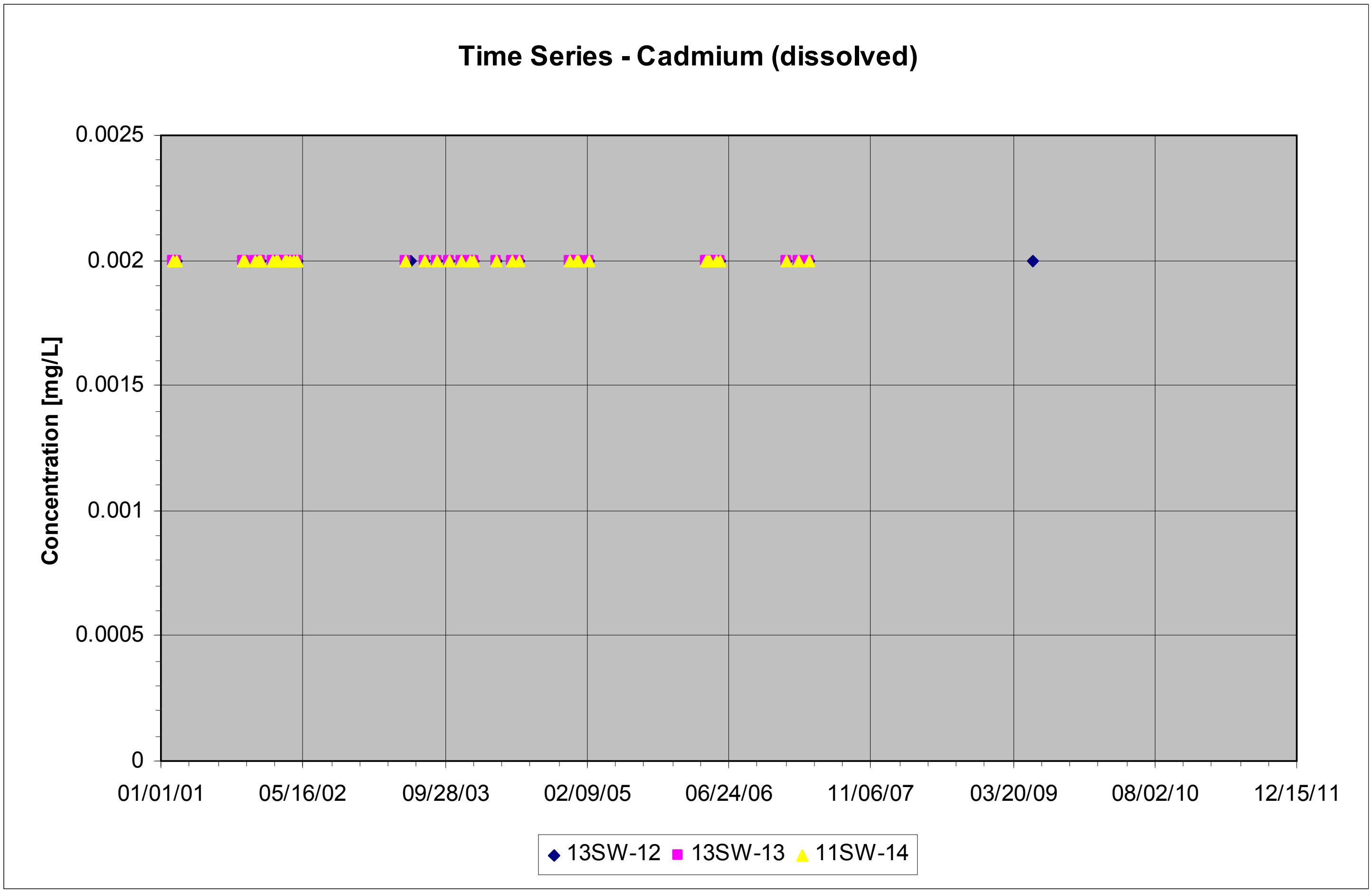

Time Series - Barium (total)
Concentration [mg/L]
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

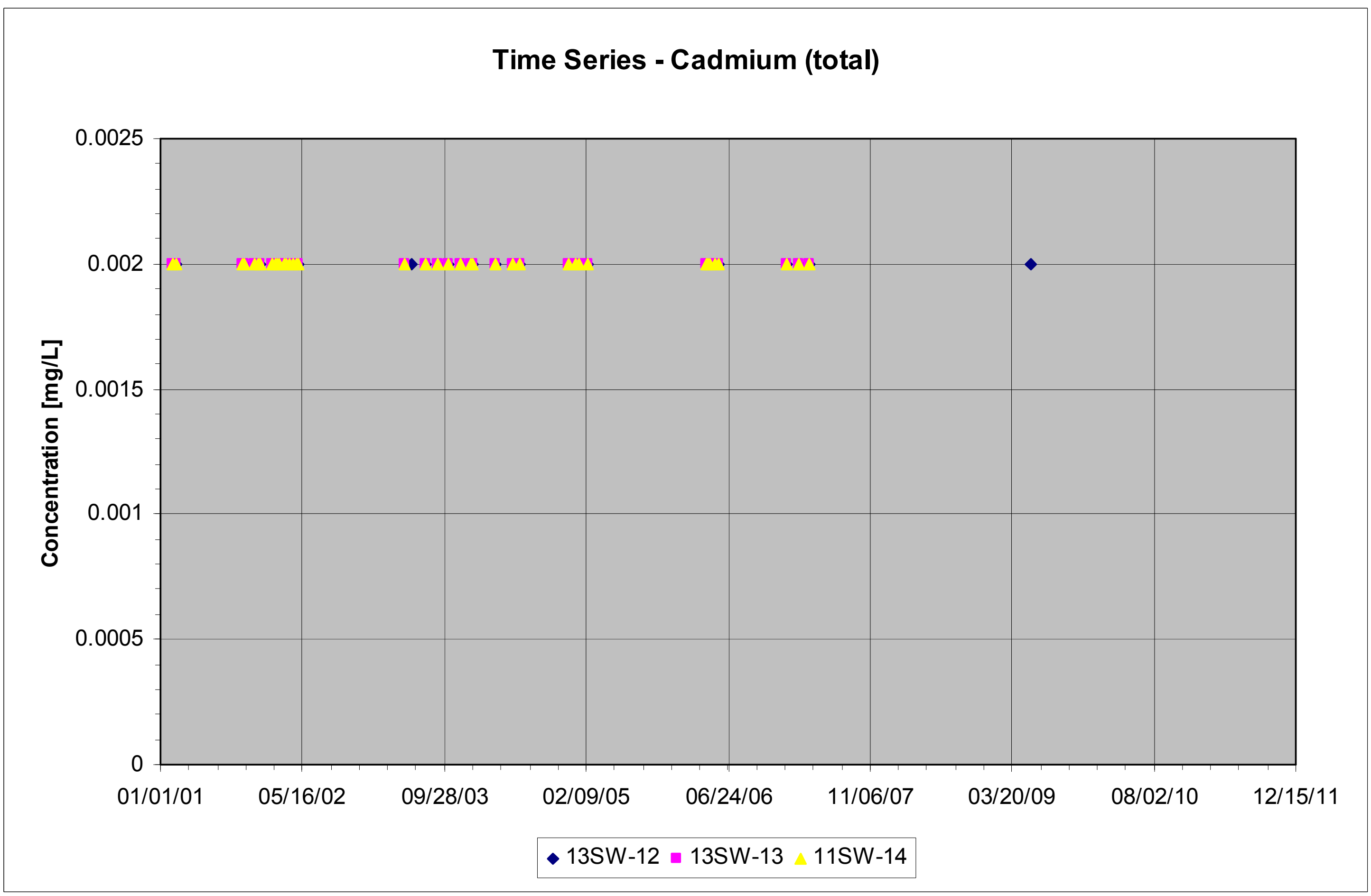


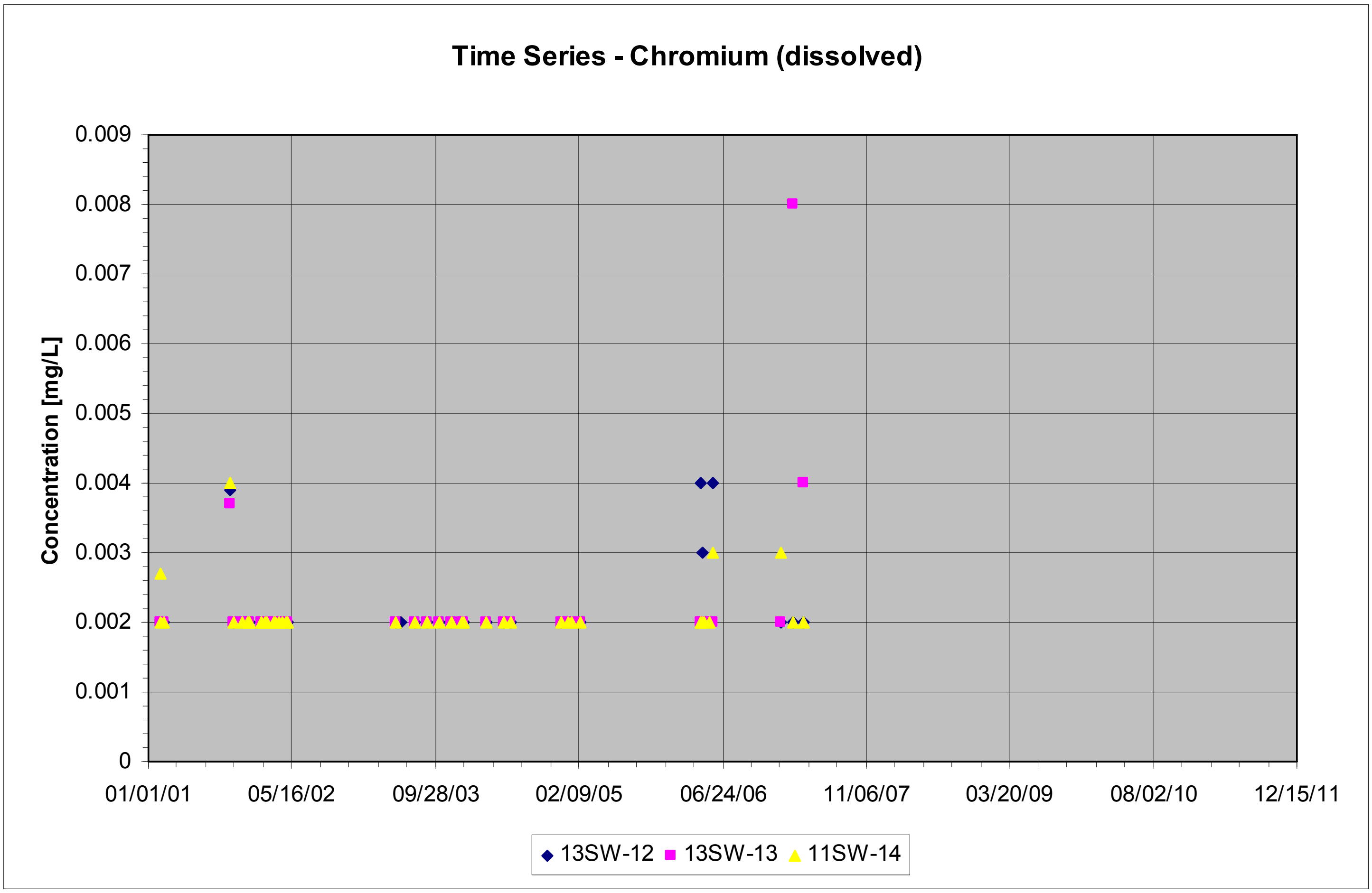
Time Series - Boron (dissolved)
Concentration [mg/L]
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14



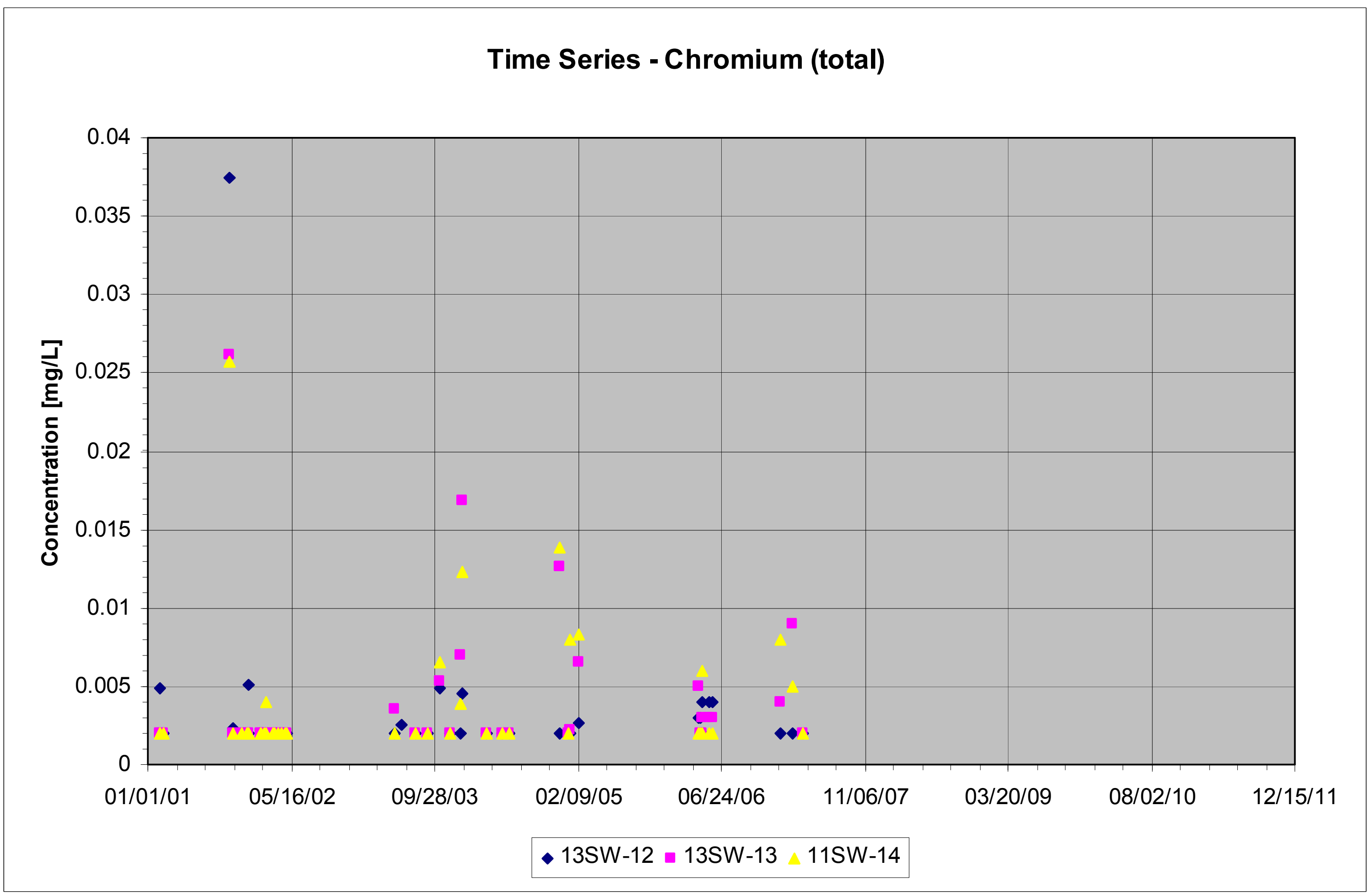
Time Series - Boron (total)
Concentration [mg/L]
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - Cadmium (dissolved)
Concentration [mg/L]
0.0025
0.002
0.0015
0.001
0.0005
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

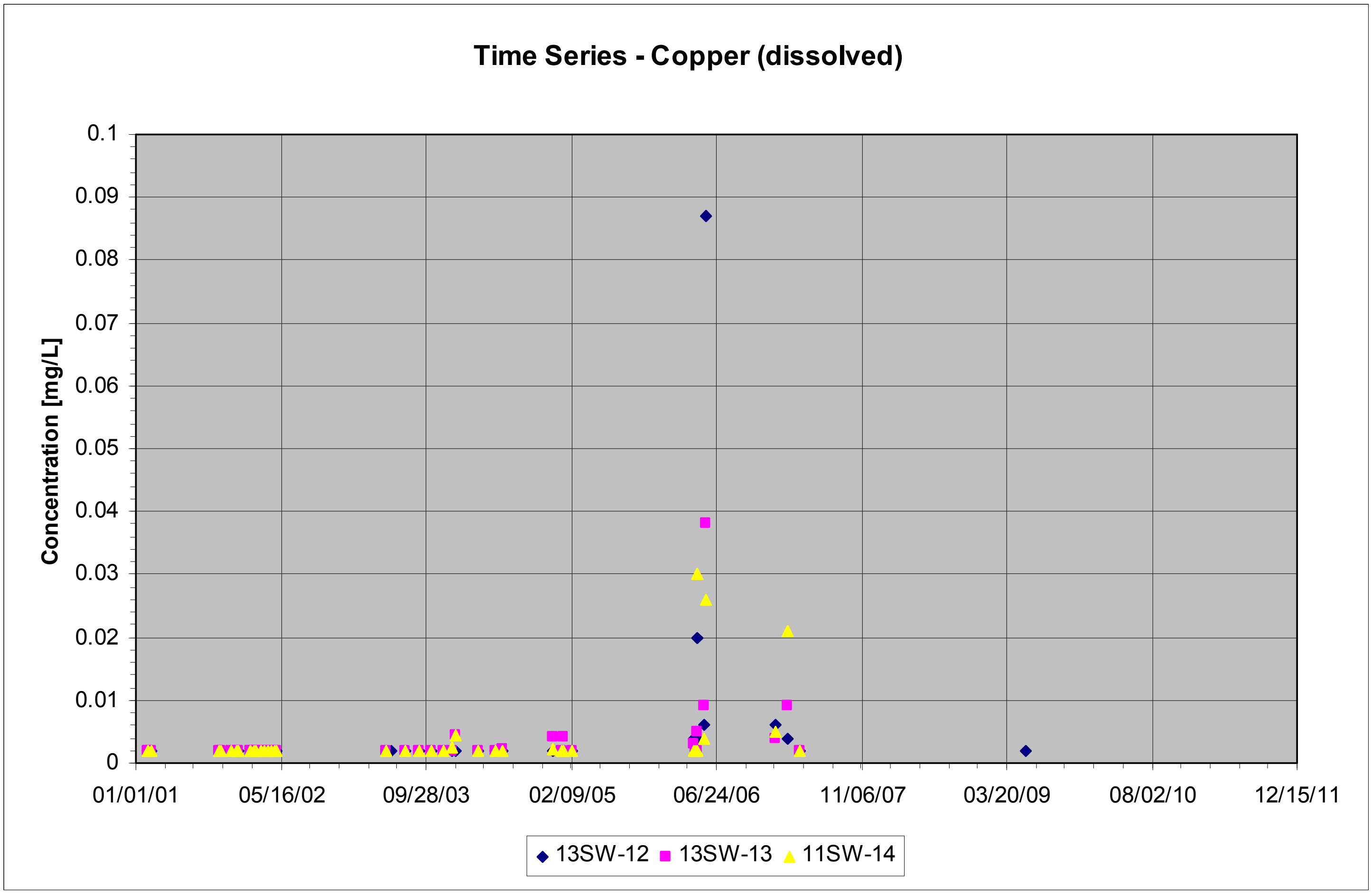

Time Series - Cadmium (total)
Concentration [mg/L]
0.0025
0.002
0.0015
0.001
0.0005
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14



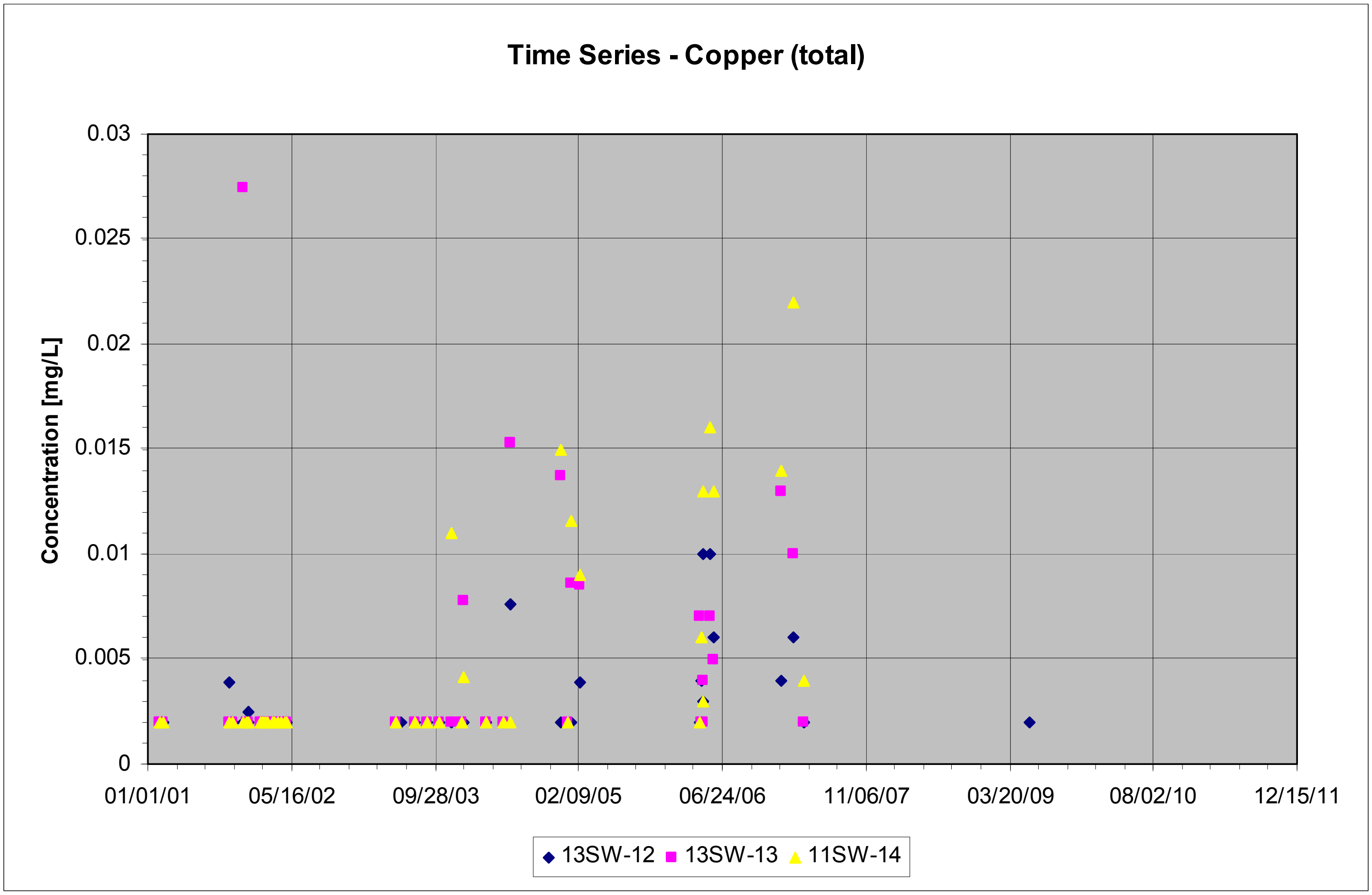
Time Series - Chromium (dissolved)
Concentration [mg/L]
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14



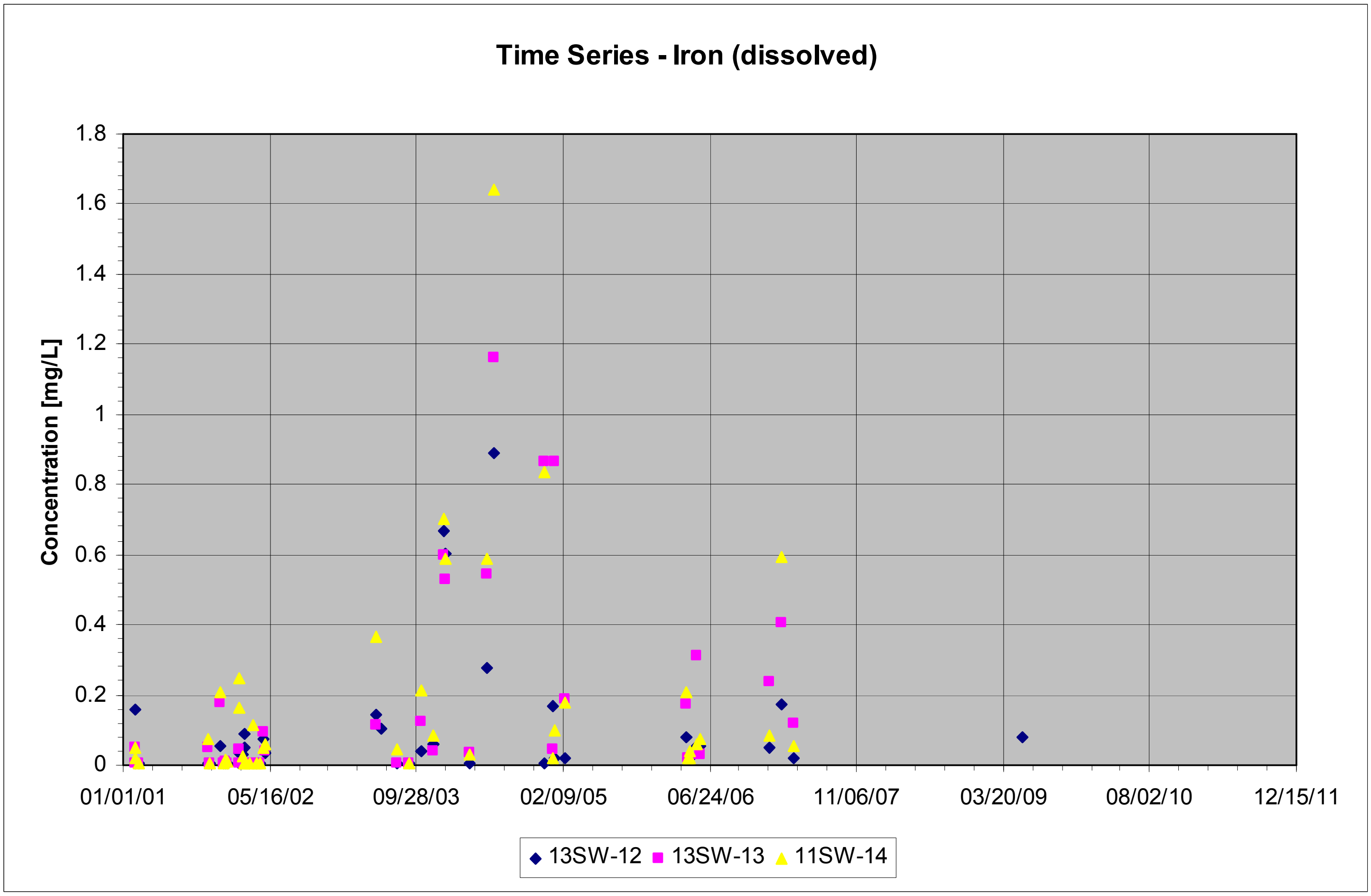
Time Series - Chromium (total)
Concentration [mg/L]
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

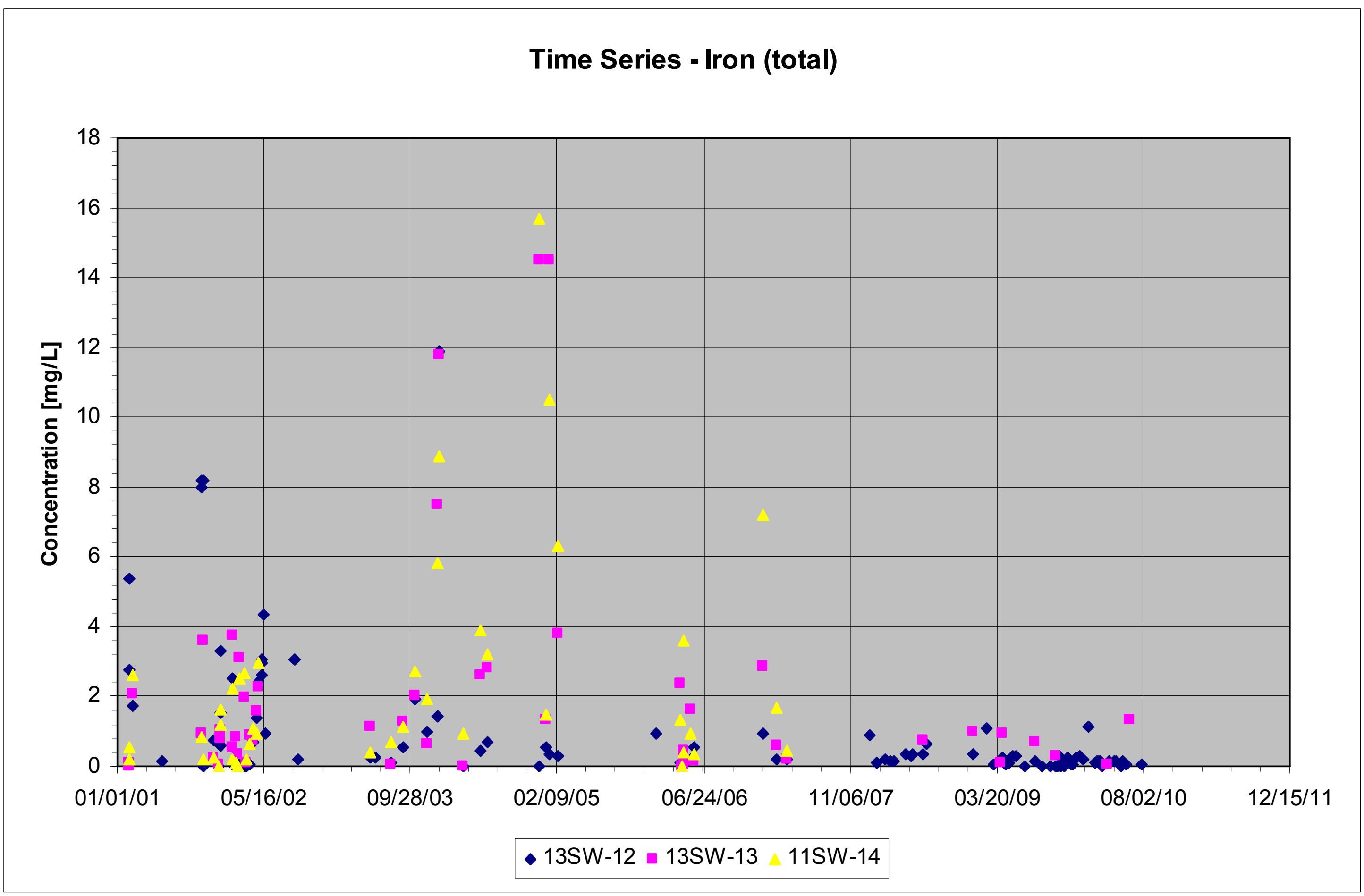


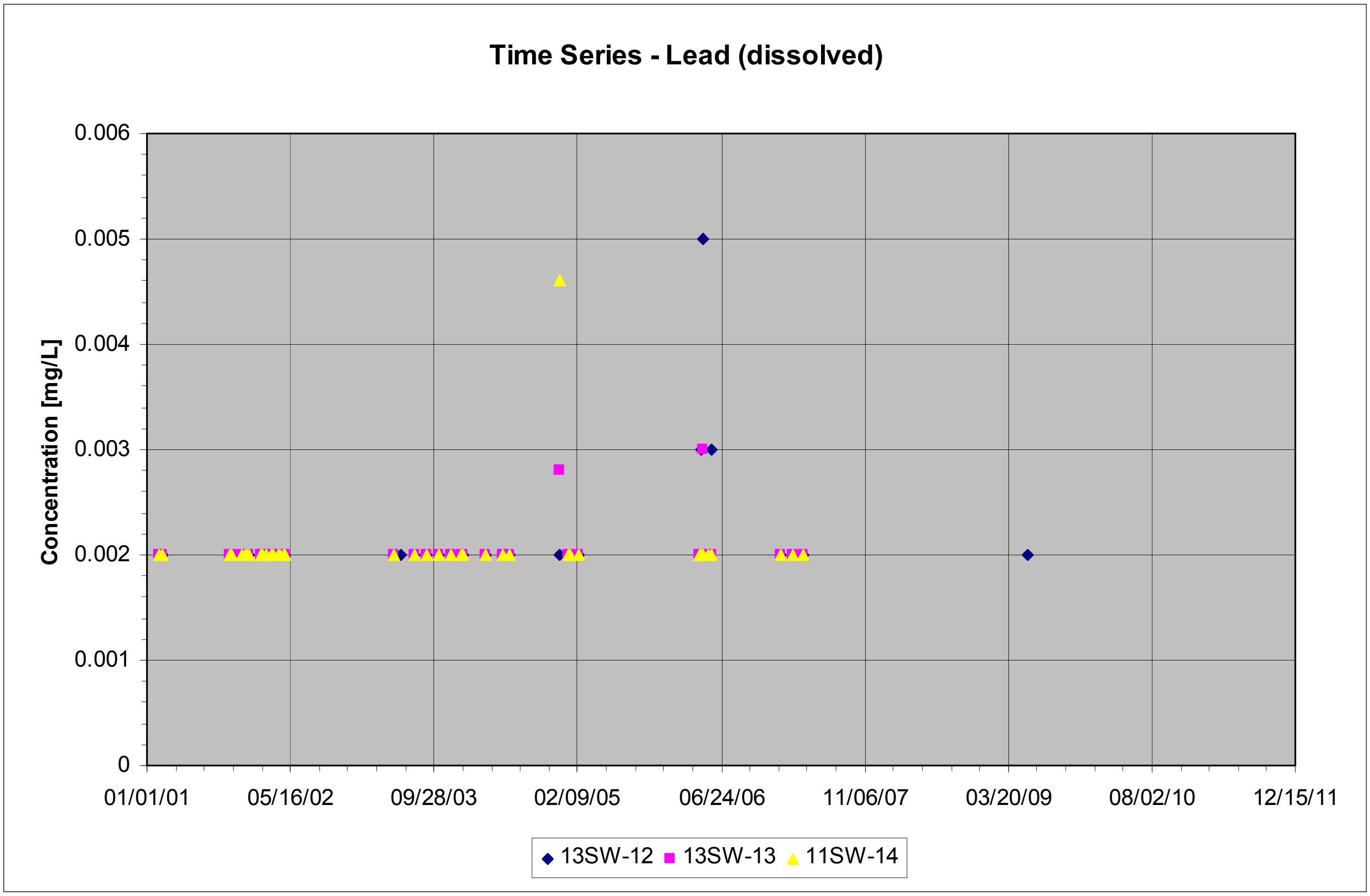
Time Series - Copper (dissolved)
Concentration [mg/L]
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14



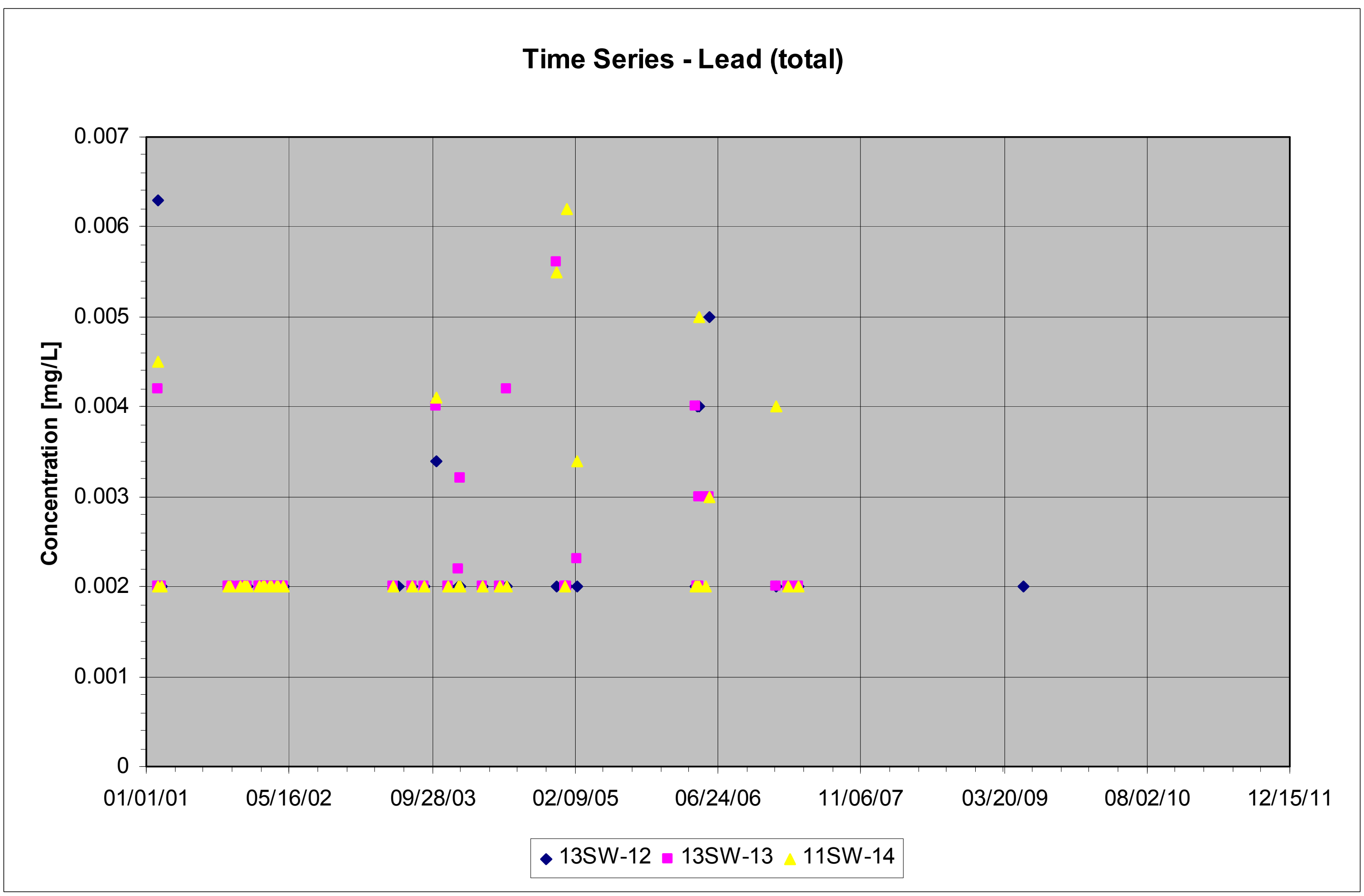
Time Series - Copper (total)
Concentration [mg/L]
0.03
0.025
0.02
0.015
0.01
0.005
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - Iron (dissolved)
Concentration [mg/L]
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

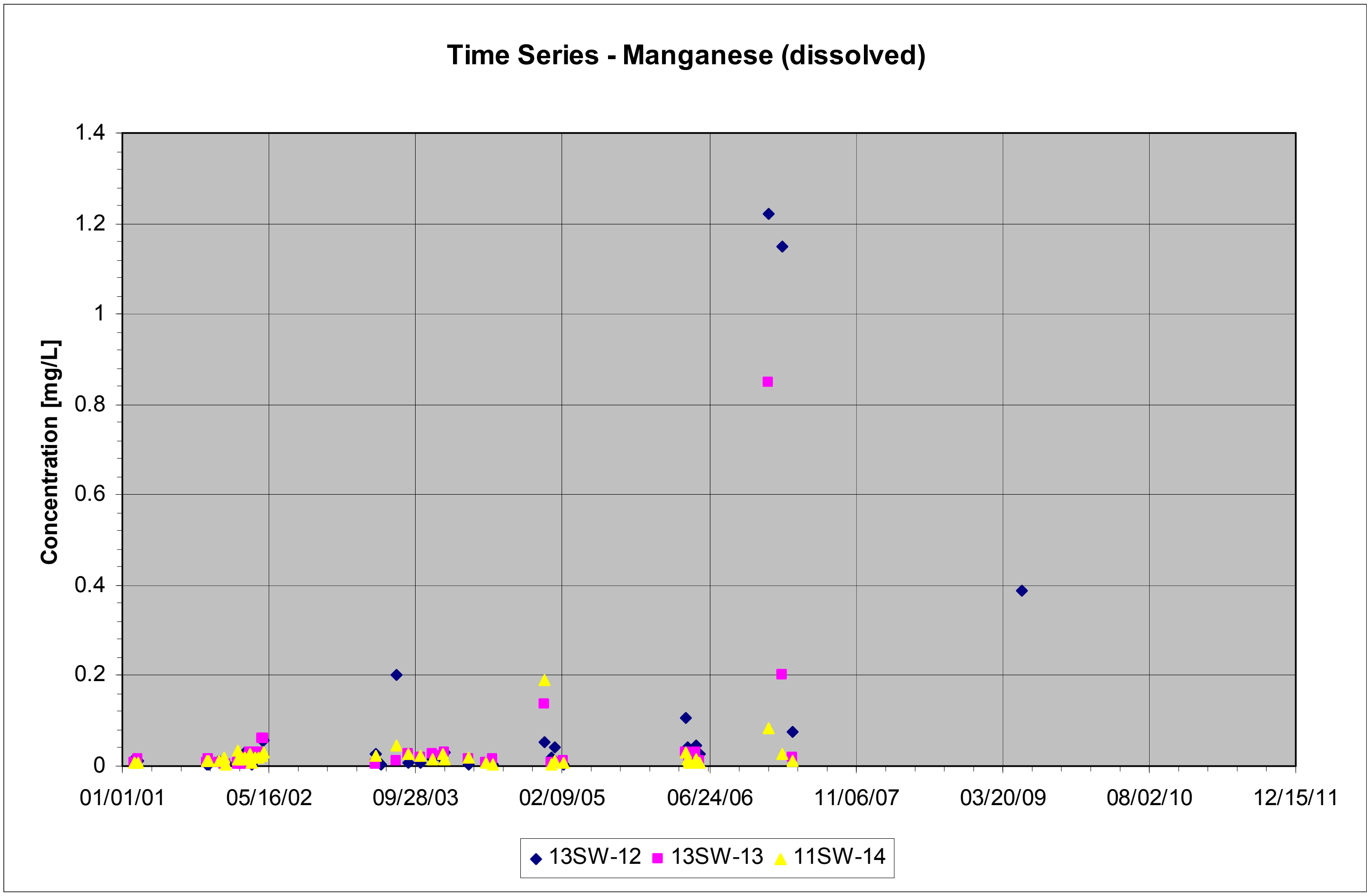

Time Series - Iron (total)
Concentration [mg/L]
18
16
14
12
10
8
6
4
2
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

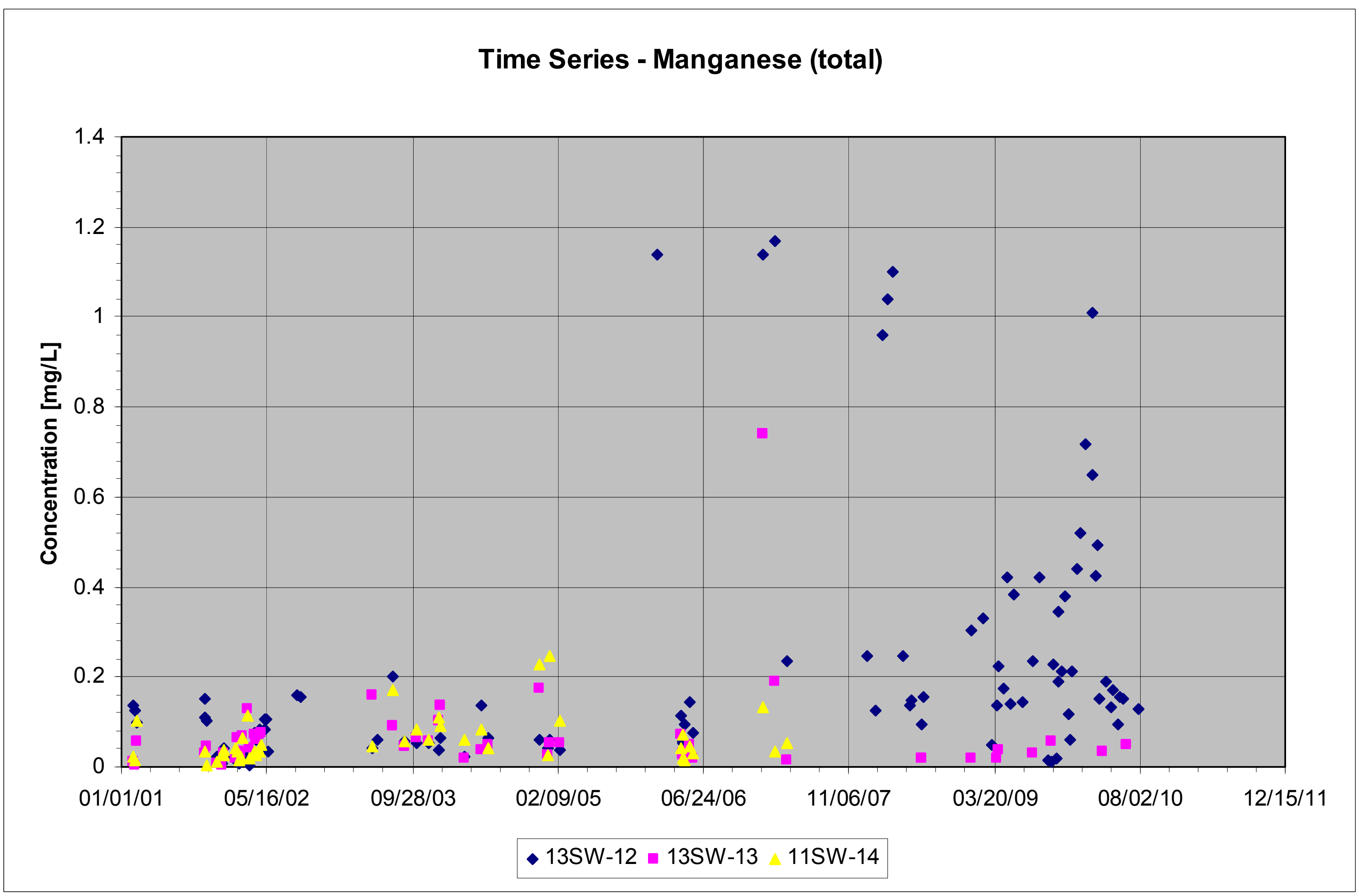


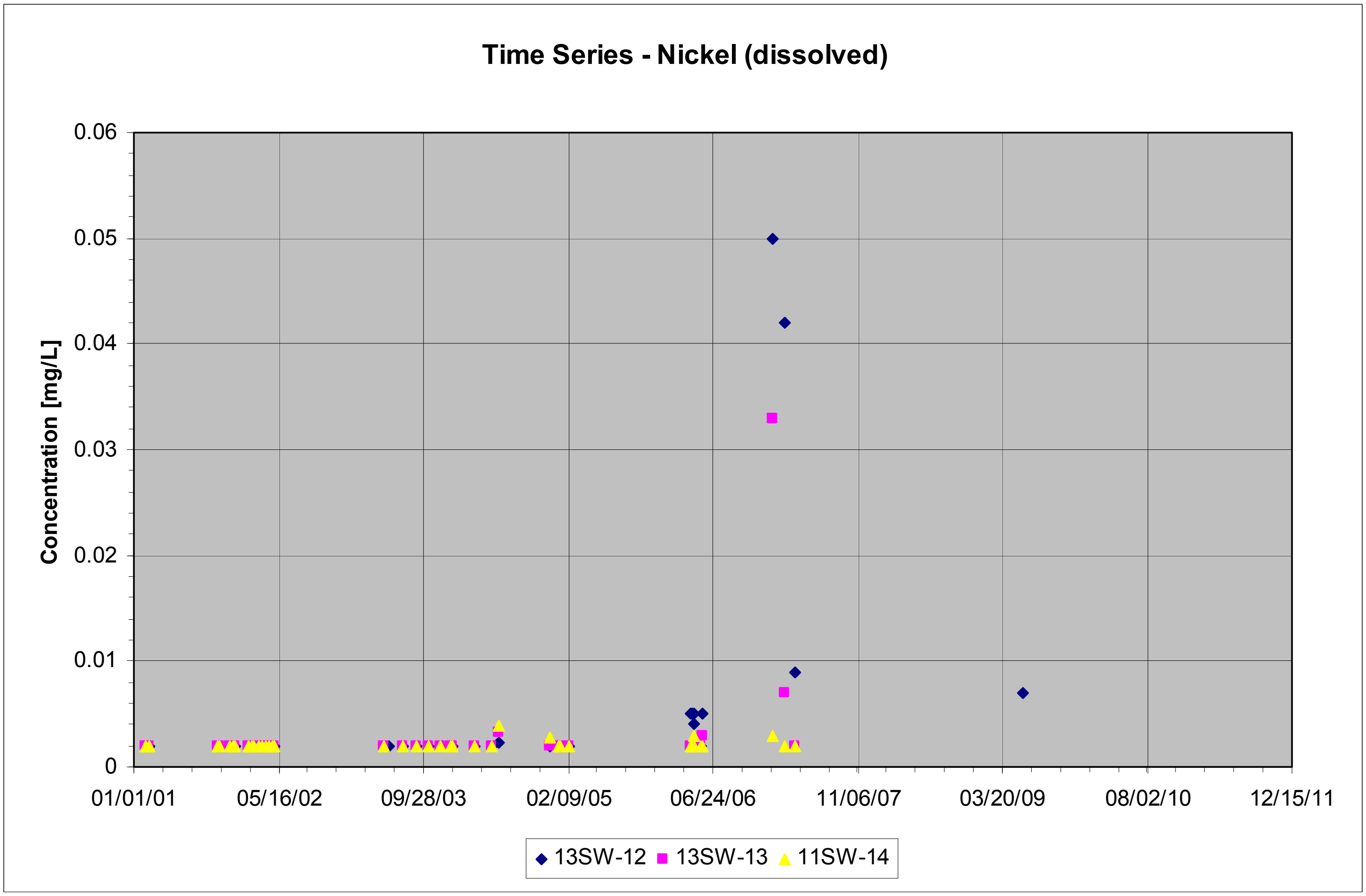
Time Series - Lead (dissolved)
Concentration [mg/L]
0.006
0.005
0.004
0.003
0.002
0.001
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

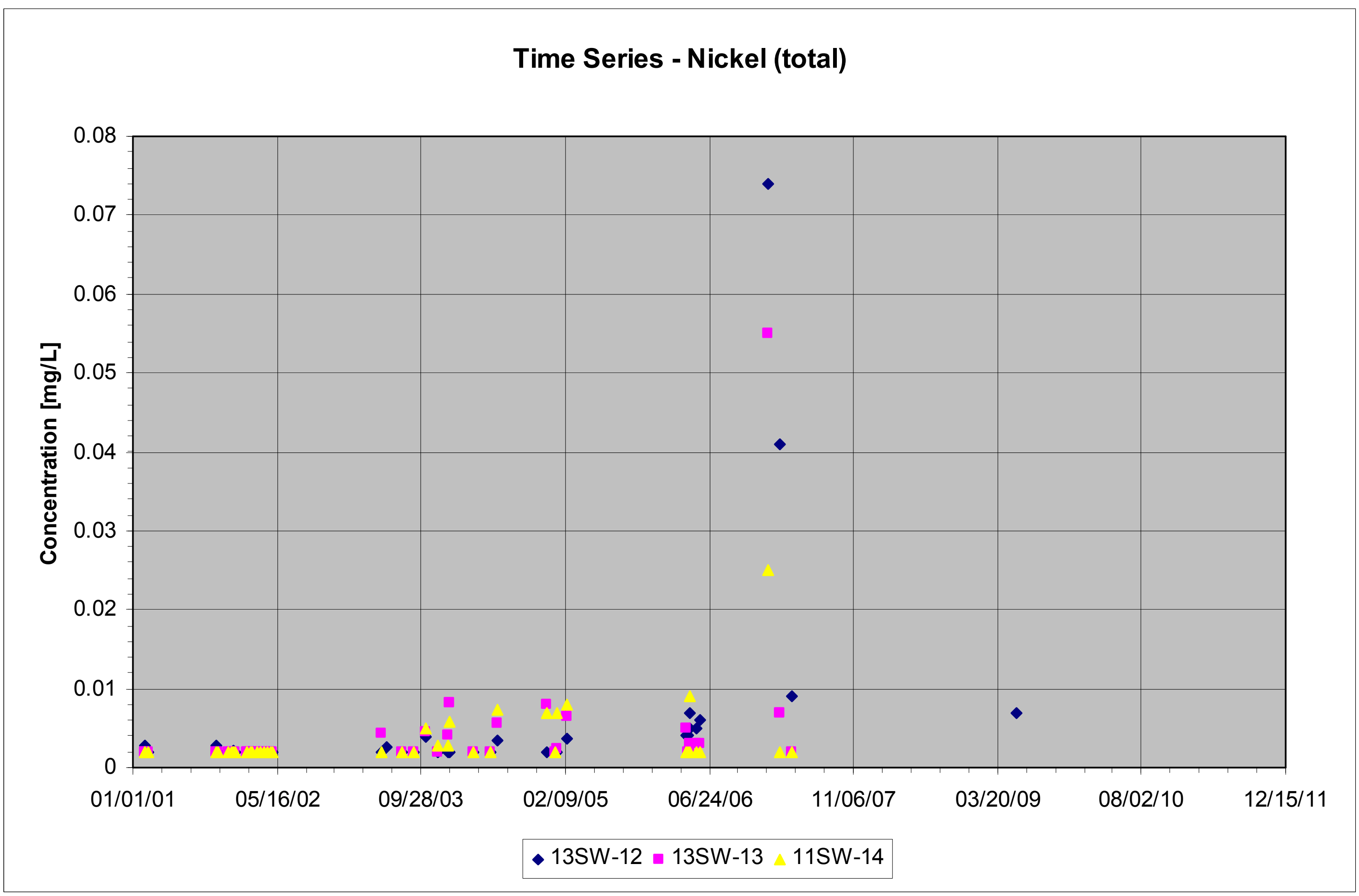


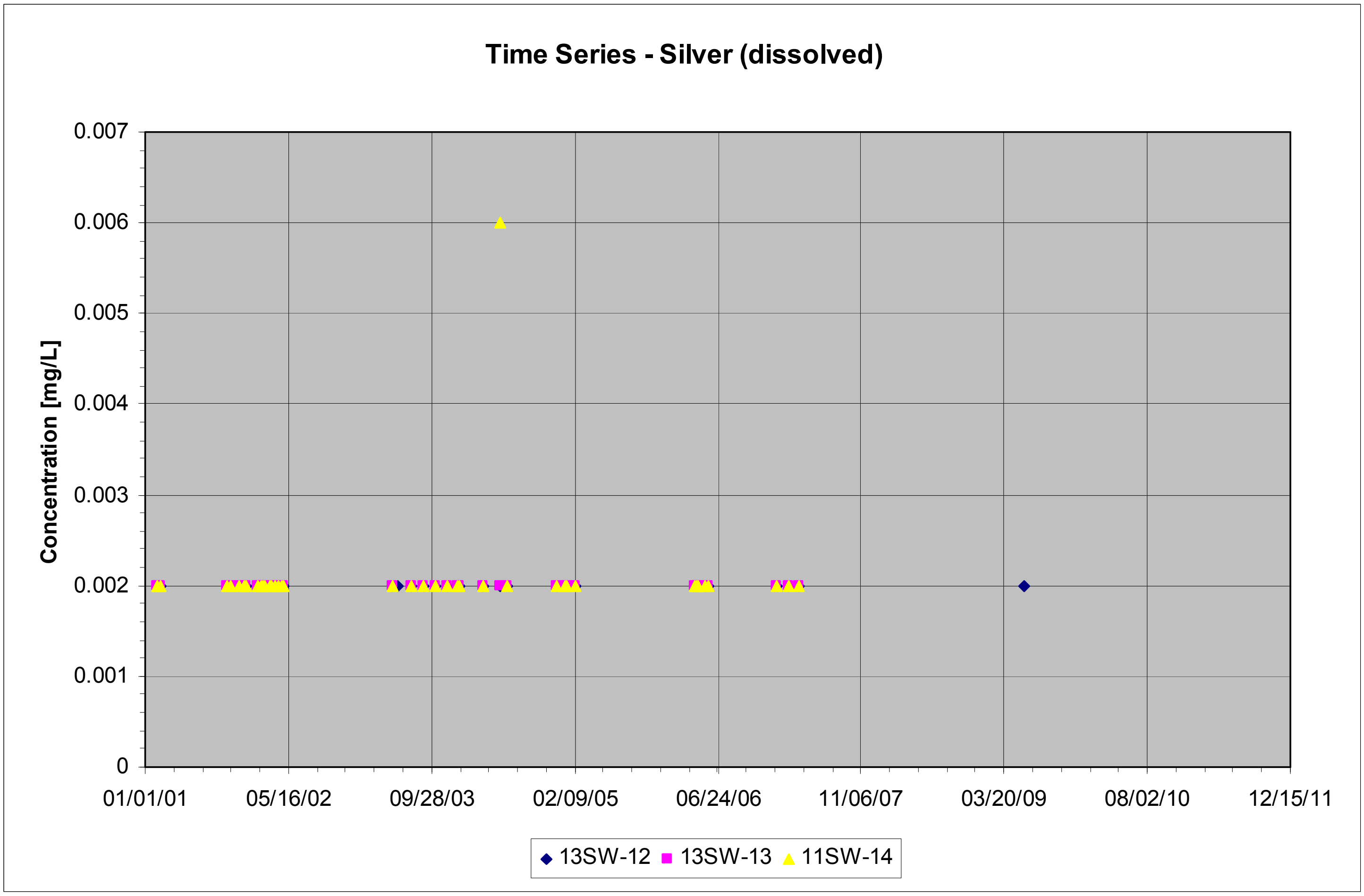
Time Series - Lead (total)
Concentration [mg/L]
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

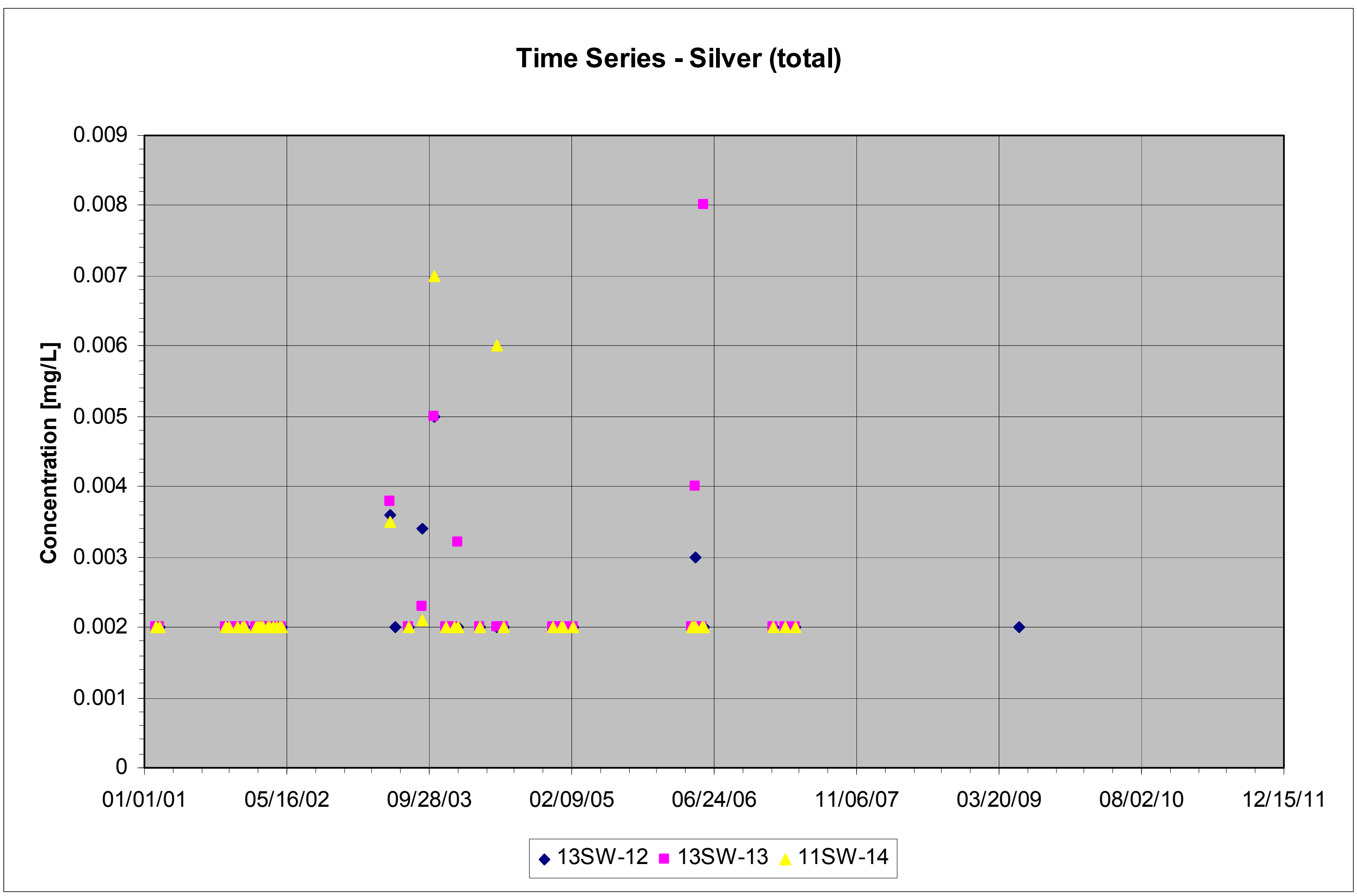

Time Series - Manganese (dissolved)
Concentration [mg/L]
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

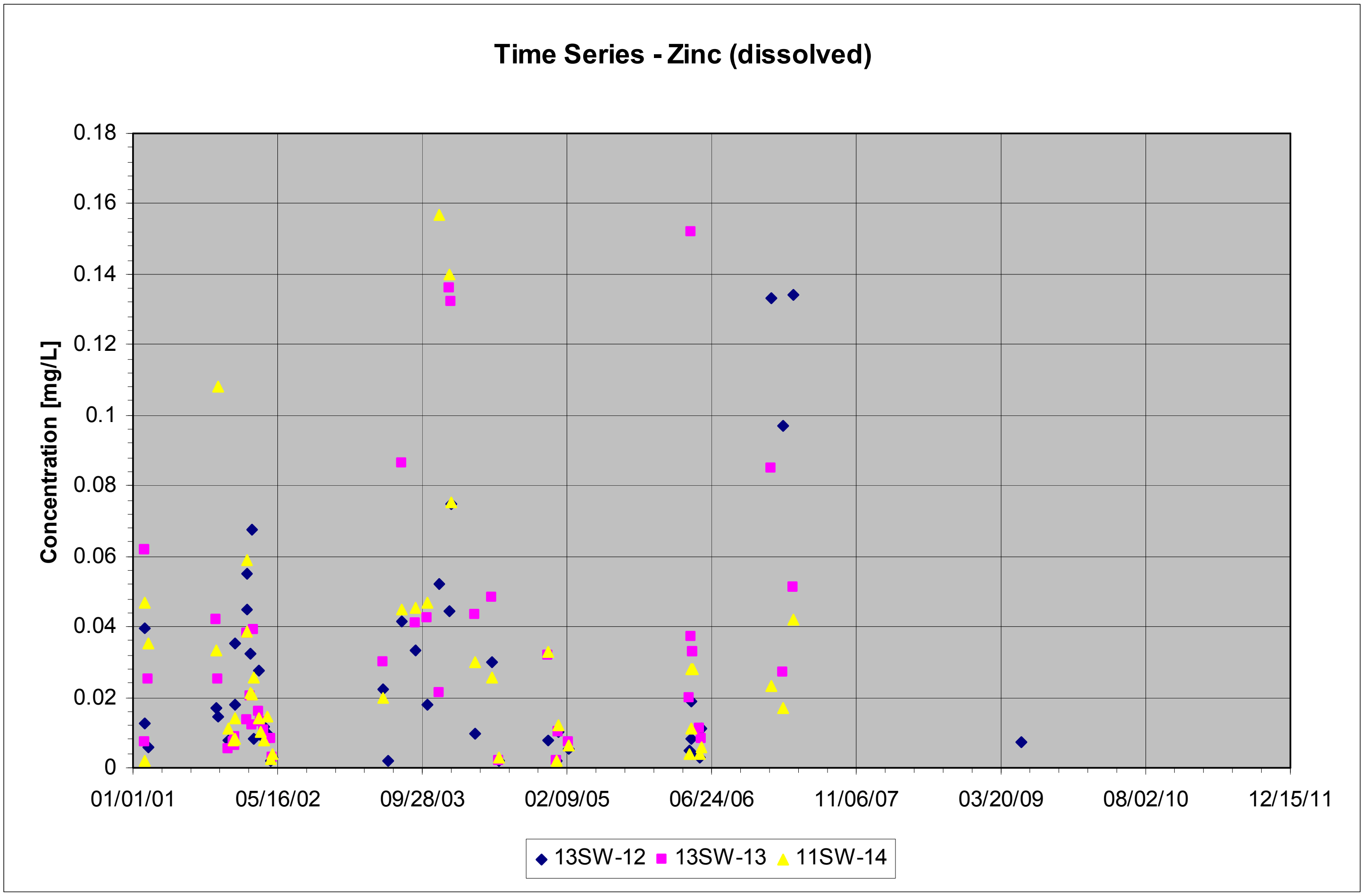

Time Series - Manganese (total)
Concentration [mg/L]
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14

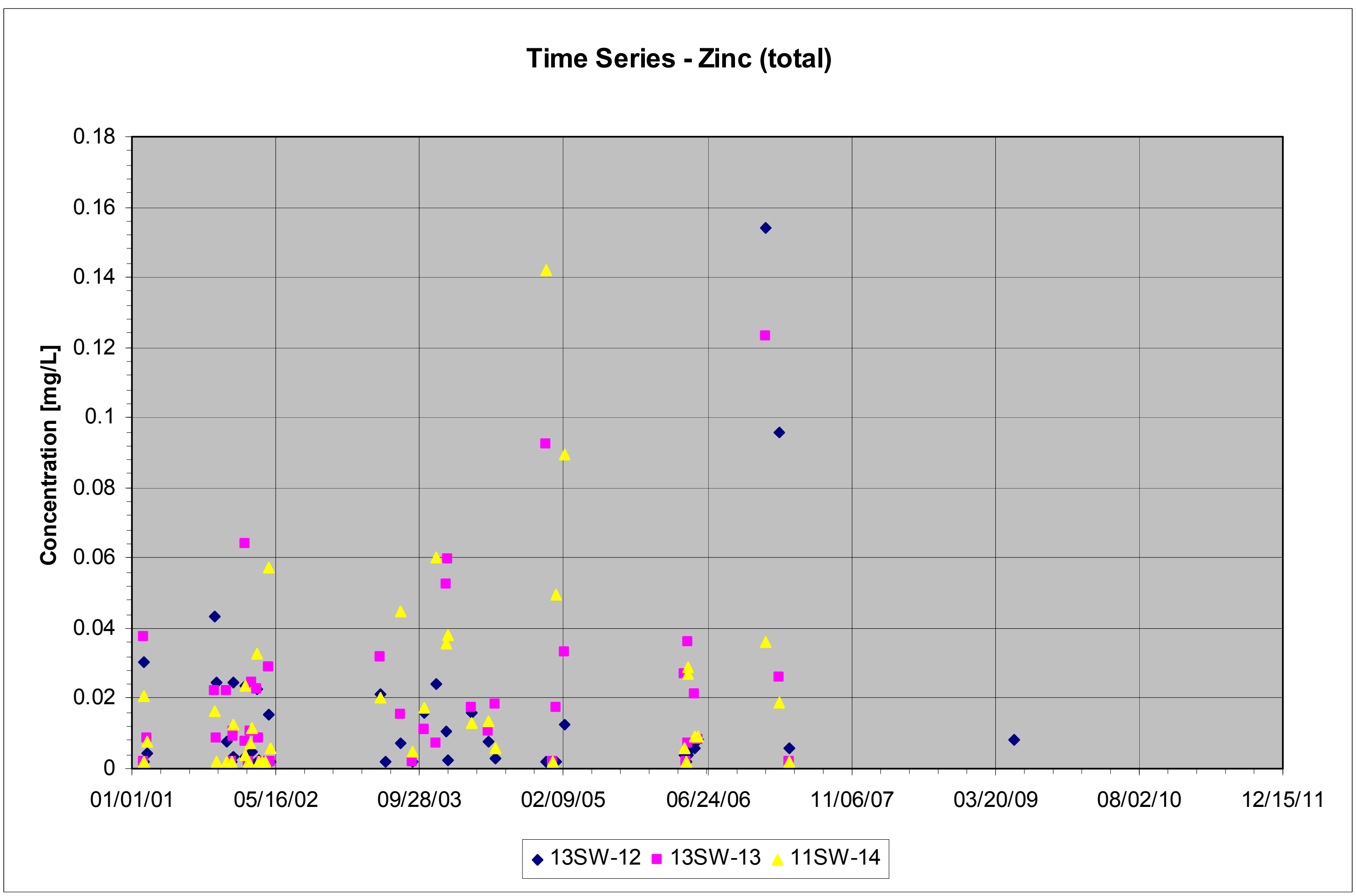

Time Series - Nickel (dissolved)
Concentration [mg/L]
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - Nickel (total)
Concentration [mg/L]
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - Silver (dissolved)
Concentration [mg/L]
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - Silver (total)
Concentration [mg/L]
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - Zinc (dissolved)
Concentration [mg/L]
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14


Time Series - Zinc (total)
Concentration [mg/L]
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
01/01/01
05/16/02
09/28/03
02/09/05
06/24/06
11/06/07
03/20/09
08/02/10
12/15/11
13SW-12
13SW-13
11SW-14